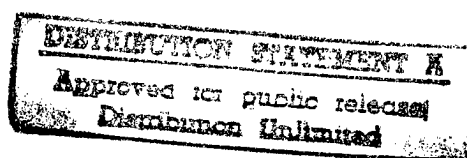


JPRS-UAC-89-010  
25 SEPTEMBER 1989



**FOREIGN  
BROADCAST  
INFORMATION  
SERVICE**

# ***JPRS Report***



DTIC QUALITY INSPECTED 2

## **Soviet Union**

### ***AVIATION & COSMONAUTICS***

No 4, April 1989

19980127 179

REPRODUCED BY  
U.S. DEPARTMENT OF COMMERCE  
NATIONAL TECHNICAL  
INFORMATION SERVICE  
SPRINGFIELD, VA 22161

# Soviet Union

## AVIATION AND COSMONAUTICS

No 4, April 1989

JPRS-UAC-89-010

### CONTENTS

25 September 1989

[The following are translations of selected articles from the Russian-language monthly journal AVIATSIYA I KOSMONAVTIKA published in Moscow. Refer to the table of contents for a listing of any articles not translated.]

Cosmonaut Titov Urges Cooperative Space Activities [G. Titov; pp 1-3]	1
Problems of Military Air Transport Regiment Aired [A. Dmitrichenkov et al; pp 4-7]	4
Fighter-Bomber Regiment Trains at Tactical Range Facility [B. Kononenko; p 8]	10
Using Music to Boost Effect of Physical Training Classes [V. Ivanov; p 9]	11
Prevention of Dangerous Incidents and Air Accidents Discussed [V. Dudin; pp 10-11]	13
Faulty ATC Procedures Cause Midair Near Misses [A. Medenkov, S. Rysakova; pp 14-15]	16
Air-Mishap Culpability Factors Analyzed [Ye. Kolomiyets; pp 18-19]	19
Cosmonaut Recovery Capsule Search and Recovery Operation [S. Skrynnikov; pp 21-23]	22
Responding To An In-Flight Emergency [pp 24-25]	24
Soviet Unmanned Space Shuttle Flight Detailed [V. Kravets, O. Babkov; pp 26-28]	24
Early "Flying Tank" Experiments Described [K. Gribovskiy; p 29]	29
Flight Surgeon Discusses Pilot Fitness, Medical Problems [S. Bugrov; pp 30-31]	30
Fulcrum Pilots Train for Tolerance to High G Forces [V. Parkhomenko; pp 34-35]	32
Training Pilots to Respond to In-Flight Malfunctions and Equipment Failures [V. Kozlov, V. Sporykhin, A. Fedoruk; pp 36-37]	35
Listing of Soviet Manned Space Mission Crews [pp 40-41]	37
Thumbnail Operational History of Mir Space Station [Yu. Semenov; pp 42-43]	41
Radio Control Systems Designer Ryazanskiy Honored [B. Pokrovskiy; pp 44-45]	43
Lack of Flight Data Recorder Tape Analysis Skills Lamented [N. Mazunin; p 45]	45
Diagram of Soviet Space Shuttle [Back cover]	46
Articles Not Translated From AVIATSIYA I KOSMONAVTIKA No 4, April 1989	46
Publication Data	46

## AVIATION AND COSMONAUTICS

No 4, April 1989

### Cosmonaut Titov Urges Cooperative Space Activities

91441288a Moscow AVIATSIYA I KOSMONAVTIKA  
in Russian No 4, Apr 89 (signed to press  
14 Mar 89) pp 1-3

[Article by Hero of the Soviet Union Pilot-Cosmonaut  
USSR Col Gen Avn G. Titov: "Soviet Peace Initiative"]

[Text] The statement issued by the CPSU Central Committee, Presidium of the USSR Supreme Soviet and Soviet Government on the occasion of Yu. A. Gagarin's historic flight on 12 April 1961 emphasized that the honor of being the first in space had fallen namely to us, the Soviet people. We consider victory in the conquest of space to be not only victory for our people but victory for all mankind, for each new discovery is placed not in the service of war but in the service of peace and the security of peoples.

An extensive program of study and exploration of space for peaceful purposes was formulated and is being carried out in the Soviet Union proceeding precisely from this principle; implementation of this program began with the launching of the first satellite in October 1957.

At the very beginning of the space age it became obvious that large-scale exploration of space was possible only by integrating the efforts of various countries and with reasonable and balanced joint utilization of these countries' scientific and technological potential. This is important not only because international cooperation in the investigation and utilization of space plays an important role in implementing scientific and economic tasks but also because it exerts substantial influence on the state and development of modern-day international relations as a whole.

Our country's more than 20 years of experience in international cooperation with the socialist countries within the framework of the Interkosmos program as well as with a number of capitalist countries on a bilateral basis attests to the fact that the future belongs to joint conquest of space. In August 1985, at the 40th UN General Assembly Session, the Soviet Union presented for consideration in this connection the "Basic Directions and Principles of International Cooperation in Peaceful Exploration of Space in Conditions of Its Non-militarization," points which were subsequently further developed, in June 1986, in a letter by N. I. Ryzhkov, chairman of the USSR Council of Ministers, to UN General Secretary J. Perez de Cuellar. This letter presents a program of joint practical actions by nations pertaining to investigation and utilization of space for peaceful purposes, calling for laying down solid material, political-legal, and organizational foundations for "star peace" up to the year 2000.

In the first, organizational phase this proposal calls for study of the needs of the peoples of the world pertaining to utilization of space technology, taking into account present capabilities and development prospects of space hardware, and also calls for holding an international conference or special UN General Assembly session to approve a long-term program of joint activities. A World Space Organization could also be established, under the aegis of which such socioeconomic development tasks as communications and navigation, search and rescue, remote earth sensing for economic purposes, study and preservation of the earth's biosphere, utilization of new energy sources, development of new materials and technologies, etc could be carried out, tasks of importance to all countries. Essential space hardware would be developed and brought into operational status in the second phase, on the basis of coordinated plans and taking into account their degree of priority and how soon they would pay for themselves. The third phase, the operational phase, would bring to all participating countries practical return on cooperation in space.

Thus by uniting the efforts of nations in peaceful space-related activities, the material and intellectual resources of mankind will be utilized effectively and efficiently. Science and technology would receive a powerful boost. Achievements in space-related industry will foster the economic and social advance of peoples to a significant degree. Thus we could help solve many of the global problems of mankind, including problems of the world ecological threat.

M. S. Gorbachev, addressing the 43rd Session of the UN General Assembly last December, spoke about this. "The Soviet Union," he stressed, "is also prepared to cooperate in creating an international space laboratory or manned orbital space station which would engage exclusively in environmental monitoring."

M.S. Gorbachev stated that features of the future space industry are increasingly more clearly taking form in the exploration and conquest of space. There is already a need, however, to draw up a comprehensive set of rules and procedures for peaceful activities in space, with a world space organization monitoring compliance with these rules and regulations. Our country has repeatedly proposed the establishment of such an organization. The Soviet Union is willing to include our Krasnoyarsk radar facility as a facility of this organization. Soviet scientists could receive their foreign colleagues and discuss with them how to convert it over to an international center for peaceful cooperation, taking down and reworking certain equipment and structures, as well as discussing the provision of additional needed equipment. This entire system could operate under the aegis of the United Nations.

The new peace initiatives submitted to the United Nations by the Soviet head of state indicate once again that the Soviet Union advocates open cooperation in space, accessible to all, without any discrimination, and bringing tangible benefit to the world's peoples. The

Soviet Union is in favor of cooperation blazing a trail for mankind into a peaceful third millennium, with large-scale joint projects involving the peaceful utilization of space and outstanding discoveries achieved thanks to unification of the efforts of all nations becoming landmarks along this road.

This past year, 1988, demonstrated that the USSR is continuing intensive cooperation with various countries in the area of peaceful utilization of space.

On 17 March a Vostok booster launched an Indian satellite, IRS-1A, into orbit. On 7 June a Soviet-Bulgarian crew aboard the Soyuz TM-5 spacecraft was launched into orbit atop a Soyuz launch vehicle. On 7 and 12 July a four-stage Proton launch vehicle lifted the Fobos 1 and Fobos 2 unmanned interplanetary probes into orbit. On 29 August a Soviet-Afghan crew was boosted into orbit aboard the Soyuz TM-6 spacecraft. On 26 November the Soyuz TM-7 spacecraft was launched, with a Soviet-French crew on board. And, finally, against the background of accomplished international programs in the peaceful exploration of space, we must note the successful launch on 15 November of the Buran space shuttle, which was lifted into orbit by the Energiya launch vehicle.

The agreement to launch the IRS-1A satellite was concluded between the Indian Space Research Organization and the Litsenzintorg All-Union Association. This is not merely the formal aspect of the undertaking. It also signifies a qualitatively new approach to joint space research, since it represented the first commercial agreement for launching foreign satellites. The Indians, covering a portion of our expenses, paid the USSR 75 million rupees. We should note that in this instance the payment made by India is substantially below the level of world market prices. This is connected with the exceptionally friendly relations between our nations as well as with the importance of ecological and resource studies in developing countries at the earliest possible time.

Regarding the commercial aspect of this matter, we must stress that the Soviet Union has stated its willingness to launch the peaceful space vehicles of other countries and international organizations with Soviet boosters on mutually acceptable terms. There are many takers, but cooperation continues to be impeded by a U.S.-imposed ban on export to the Soviet Union of space hardware components manufactured in the United States. And such components are present on virtually all the hardware of our potential partners. Obstacles remain, in spite of an appeal to the U.S. State Department by our potential clients and the fact that Soviet Government bodies offer our clients the necessary guarantees of the safeguarding of their space vehicles while on Soviet soil, from the moment they cross the border right up to liftoff.

The Fobos 1 and Fobos 2 unmanned interplanetary probes (AMS) are tasked with investigating the planet Mars, its moon Phobos, the sun and interplanetary

space. These probes, which comprise new-generation unmanned space vehicles, were designed and built at the Scientific Experimental Center imeni G. N. Babakin of USSR Glavkosmos, with the participation of many design engineers and industrial enterprises. Alongside Soviet scientists, specialists from Austria, Bulgaria, the Hungarian People's Republic, the GDR, Ireland, Poland, Finland, France, the FRG, Czechoslovakia, Switzerland, Sweden, and the European Space Agency took part in drawing up the Fobos scientific program and in developing project scientific apparatus and equipment.

It is interesting to note that when the Fobos 1 probe was launched, a delegation from the U.S. Air Force, led by Lt Gen Donald L. Cromer, was on hand at the Baykonur space launch facility in addition to representatives of national and international organizations and the mass media from the countries taking part in the Fobos project, and representatives of major British, Italian, U.S. and West German insurance companies were present at the launch of Fobos 2. The purpose of the visit by these insurance executives was to create more favorable conditions for attracting the companies they represent to take part in insuring possible future commercial payloads to be underwritten by a Soviet insurance company (Ingosstrakh). Incidentally, both the U.S. experts and insurance company people, who visited the assembly and testing building and inspected the Proton booster which launched the Fobos probes, had very high praise for it.

Project Shipka is the name our Bulgarian friends gave to activities pertaining to preparing for and carrying out the second joint space mission. Shipka [a mountain pass in Bulgaria] is a symbol of the brotherhood in arms of Russian and Bulgarian fighting men, which 111 years ago led to the liberation of Bulgaria from the Ottoman yoke. Today's "Shipka" is a fraternal cooperation among the scientists of the two countries in the peaceful exploration of space for the benefit of our peoples and for the benefit of all mankind.

All 42 experiments scheduled for the Soviet-Bulgarian crew were fully completed. An extensive program of geophysical investigations was performed, including photographic imaging and spectrometry of the People's Republic of Bulgaria, the Black Sea, and other areas of the earth's surface. The obtained information will be used in performing many scientific and economic tasks.

Final adjustment of a multipurpose astrophysical complex was performed during the mission, as well as several series of experiments pertaining to study of galactic and extragalactic radiation emissions sources, the interplanetary medium, and physical processes taking place in the ionosphere and the earth's atmosphere. The space materials science program resulted in obtaining specimens of single crystals of metal alloys and composite materials with improved characteristics. Medical experiments aimed at comprehensive investigation of man's state of health and work fitness during the period of adaptation

to weightlessness occupied an important place in the activities of the international crew.

A. Solovyev, V. Savinykh, and A. Aleksandrov performed efficiently and at a high professional level at all phases of the joint mission. The successfully-completed joint Soviet-Bulgarian mission is an example of fruitful international cooperation in the peaceful conquest of space and signals further strengthening of the everlasting, indestructible friendship between the peoples of the Soviet Union and the People's Republic of Bulgaria.

The bulk of the data for the program involving investigation of Afghanistan's natural resources was obtained with a KATE-140 fixed-mount topographic camera. During the joint mission several medical experiments were carried out, as well as investigations in the area of physics of the upper atmosphere; experiments were continued on further study of the development of higher plants in conditions of weightlessness, and experiments were conducted on growing single crystals of protein preparations.

The Soviet-Afghan mission is not only of scientific and economic significance but of great political significance as well. We should note that it took place at the time when withdrawal of the limited Soviet forces from Afghanistan began. It is also symbolic that this mission took place during the year of the 10th anniversary of the April National Democratic Revolution in Afghanistan.

The 15th international mission differed radically from all previous joint missions. Instead of 7-10 days, as in the past, the Soviet-French international crew spent almost a month in orbit. Jean-Loup Chretien became the first foreign cosmonaut to fly a second Soviet manned mission and to take part in an EVA.

France attached great significance to the joint mission. French President Francois Mitterrand scheduled his meeting with M. S. Gorbachev, General Secretary of the CPSU Central Committee and Chairman of the Presidium of the USSR Soviet, to coincide with the Baykonur launch. Incidentally, Mitterrand and M. S. Gorbachev "fathered" the plan for an extended mission by a French astronaut, a basic agreement on which was reached during M. S. Gorbachev's visit to France in October 1985.

On 26 November 1988, precisely 4 hours prior to the scheduled launch, an Il-62 aircraft landed at the airport by the town of Leninsk, bringing the French President and the USSR Minister of Foreign Affairs. F. Mitterrand headed directly from the airport, accompanied by a horde of journalists, for the assembly and testing building, where crew members A. Volkov, Jean-Loup Chretien and S. Krikalev were in the final stages of donning and testing their spacesuits. The French President passed on to them warm wishes from the entire French people.

The French President devoted the two and a half hours allocated to final prelaunch preparations after the crew boarded the shuttle to conversation with the space launch facility test personnel. He inspected the Soyuz TM and Progress spacecraft and the Soyuz launch

vehicle, and he showed particular interest in a spacesuit with a self-contained EVA propulsion unit. The test people informed him that this unusual device will soon be delivered to the Mir space station. The visitors were shown the Buran space shuttle and the Energiya launch vehicle. F. Mitterrand also visited the S. Korolev and Yu. Gagarin museum cottages and viewed the exhibits at the Museum of Space Exploration.

The French President held a press conference in the assembly and testing building for Soviet and foreign journalists, at which he summarized his working visit to the USSR and his conversations with M. S. Gorbachev. He expressed satisfaction with the results of these conversations and gave an optimistic appraisal of prospects for Soviet-French cooperation in many areas, including joint space research.

Following the launch of the Soyuz TM-7, the French President departed for Paris aboard a supersonic Concorde aircraft from the same runway on which the Buran orbital vehicle had landed after having completed two orbits of the earth.

The Soviet-French mission aboard the orbital complex lasted 23 days. On 21 December Jean-Loup Chretien returned to earth together with Soviet cosmonauts V. Titov and M. Manarov, who had accomplished the historic first of spending an entire year in space.

The launch of the Buran space shuttle into orbit and its successful return to earth ushers in a qualitatively new stage of the Soviet space program and considerably expands our capabilities in space exploration. Henceforth the Soviet space program will have not only the means to insert heavy payloads into various orbits but also the capability to return them to earth.

Utilization of the new space shuttle system in combination with expendable boosters and permanent manned orbital space stations enables us to concentrate our main efforts and resources on those areas of the space program which will ensure maximum economic return to the economy and will advance science.

The successful flight of the Buran orbital vehicle can rightly be called one of the greatest scientific, engineering, and production accomplishments of the scientists, designers, engineers, technicians, construction workers, other workers, and specialist personnel at the Baykonur space launch facility, at Mission Control, in the space command, control and telemetry system, and at the shuttle landing facility—everybody who worked on development, construction, and testing of the space shuttle system, those who designed and built the highly complex technical, launch, and landing facilities, and those who took part in preparation for and conduct of this flight.

The conquest of space is grounded on utilization of the latest advances in science and technology. Naturally the greatest results are also achieved in this program. They

directly influence development of the basic sciences and can be utilized for the benefit of the peoples of the entire planet.

Economic activity not only of individual countries but of entire continents is inconceivable today without TV transmission, meteorological, navigational, and other satellite systems. Therefore common plans for the conquest and utilization of space are essential. By working together we can achieve the desired results more easily and faster.

Specialists in the field of space greeted the new year 1989 with hope, with hope and optimism grounded on the positive changes which are taking place in international relations, on the new political thinking, and on the new understanding of concern for the fate of our planet. Let us hope that joint peaceful programs will experience further development in the interests of all mankind.

COPYRIGHT: "Aviatsiya i kosmonavtika", 1989.

### Problems of Military Air Transport Regiment Aired

91441288b Moscow AVIATSIYA I KOSMONAVTIKA  
in Russian No 4, Apr 89 (signed to press  
14 Mar 89) pp 4-7

[Article, published under the heading "Following a Policy of Perestroyka," by AVIATSIYA I KOSMONAVTIKA special correspondents Col A. Dmitrichenkov, Lt Col N. A. Antonov, and S. Skrynnik: "Realities and Potential"]

[Text] In his address at the 27th Conference of the Moscow city CPSU organization, M. S. Gorbachev, General Secretary of the CPSU Central Committee and Chairman of the Presidium of the USSR Supreme Soviet, stated: "Things are difficult at the present time, but we shall continue in the future telling people the truth, everything just as it is! We shall not be devious or crafty, fooling ourselves with the claim that perestroyka has already changed everything around. You and I have been deliberating the question for two or three years now: where are we, and what is happening around us? It has taken time to hammer out a policy of perestroyka. And only now are we really proceeding to implement this policy."

The thoughts he expressed also apply in certain measure to the daily lives and activities of the personnel of a certain military air transport regiment. How perestroyka is progressing and how democratization and glasnost are being implemented in this unit will be the subject of the following article, prepared from materials gathered by an AVIATSIYA I KOSMONAVTIKA field team, made up of special correspondents Col A. Dmitrichenko, Lt Col N. Antonov, and S. Skrynnikov.

\*\*\*

### Routes of Courage

The regiment under the command of Col V. Kornilov has a glorious history. It was formed in the spring of 1944. Its crews soon mastered the Li-2 aircraft. Its first

combat action was in the Vitebsk-Mogilev-Bobruysk sector. Its pilots flew 248 combat sorties in 15 days of intensive action. By war's end the regiment had logged a total of 1,962 sorties. Its aircraft had dropped more than 8,000 bombs and hauled 210 tons of supplies. In combat action the regiment's aircraft destroyed 20 enemy rail consists, more than 70 ammunition and POL dumps, knocked out two river-crossing sites, and destroyed 18 aircraft on the ground and three in the air. Many of the regiment's men were awarded medals and decorations for their courage and heroism.

In peacetime the regiment's personnel have continued mastering modern combat equipment and strengthening operational readiness. In the unit's combat history room there is a map showing the routes the regiment's crews have flown. Dozens of lines stretch from the regiment's home field in all directions, and each one signifies performance of important missions for the state, the Armed Forces, and the nation's economy.

It suffices to list just a few of the destinations in order to appreciate their diversity, importance and complexity: Damanskiy, Vietnam, Chernobyl, Armenia, Afghanistan. And as a rule the regiment's aircrews were among the first on the job and among the last to depart. Aircraft flown by officers I. Zelenskiy, V. Ivanov, V. Fedoseyev, and V. Davydov, for example, went to Armenia at its hour of need. The crews led by Maj I. Barsukov, V. Ilyasov, Yu. Khristoforov, and others fully carried out their internationalist duty in the Republic of Afghanistan.

The crew under the command of Military Pilot 1st Class Maj Yu. Khristoforov made many flights to Afghan airfields to pick up wounded and sick military personnel. The crew members call their aircraft "the scalpel," and for good reason. Wounded were frequently given emergency medical assistance aboard this aircraft.

The men do not readily talk about their exploits, but one thing is clear: they have saved the lives of many of our officers and men.

But then there came another calamity, not a natural disaster but a situation deliberately caused by Afghan extremists who were attempting to isolate and seal off certain towns. And once again Soviet military aviators came to the assistance of Afghan civilians. These included the crew led by Maj V. Ilyasov; they delivered medical supplies, food supplies, and other nonmilitary goods. Unfortunately we were unable to meet them: they were on temporary assignment elsewhere. Where? Once again where speed, skill, courage, and reliability are required. It is these qualities which perhaps most fully characterize all the men of this regiment.

### Special Attention Toward the Young Ones

It has become a fine tradition in the regiment to surround young officers with attention and concern from the very first day and to help them gain confidence and overcome difficulties which arise. Commanders and

political workers, party committee and Komsomol committee plan and carry out combined activities aimed at raising their ideological-theoretical level and developing persisting moral-psychological and professional qualities.

In the course of improving training an atmosphere is always created which maximally promotes increase in flying skill and development of tactical thinking, independence, and initiative. And all this is rigorously monitored by one's senior comrades, who do not diminish but on the contrary broaden opportunities for the lieutenants to display their knowledge and abilities.

Commanders make intelligent and reasonable use of their invested authority to order and require, persuading and teaching their subordinates by example of their own personal professionalism, composure, efficiency, and respect for flight rules and regulations. Veteran instructors Lt Col V. Ivanov and Majors A. Ruslanov, A. Antonov, V. Suzdaltsev, and V. Ilyasov proceed precisely in this manner. Regimental deputy commander Lt Col N. Kondrushin said about them, these acknowledged mentors of youth, in no uncertain terms and with full conviction: "Innovative people."

Yes, in this regiment they well understand the importance of cadre reserves and entrust responsible, gifted, and enthusiastic individuals with this job. In other words, persons who have a particular sense of flying.

Upon reporting for duty to the regiment from flight school, as a rule the young lieutenants are made copilots. Some of them complain: "How can anybody ever get a chance to show what he can do?" But this opportunity only seems limited. Although their duties are rigorously defined, it is possible to show what one can do, to show one's ability. What sets some young pilots apart? It is first and foremost (and this is immediately obvious) a serious attitude toward their job, conscientious performance of those "strictly defined" duties, and a high degree of pilot discipline. Another important factor is the degree to which a lieutenant becomes an integral part of the crew and how he handles volunteer activities.

In this regiment they approach determination of candidates for the "left seat" precisely with these fundamental criteria. They have formed their own system of views here for resolving this matter in a high-quality manner. Synthesizing thoughts, ideas, and specific suggestions, in this regiment they reached the conclusion that a determining role in the development of a young pilot and his forming and shaping as a pilot in command is played by reasoned selection of his path in military aviation during his years as a lieutenant, for a person contributes the greatest benefit when he receives satisfaction from his chosen profession. This is one of the operating factors in the perestroika taking place in the regiment, which consists essentially in dealing with personnel taking into account the lieutenants' interests, desires, abilities, and aspirations.

To evaluate the genuine qualities of young pilots in a correct and timely manner means to predetermine their pilot career. In this regiment they endeavor not to change around the makeup of the crews. This too is done for the purpose of studying the younger aircrew members. They keep a close watch on the younger men and help them in every possible way. There definitely should be no haste. Only after a year or perhaps more of service with the unit, when a lieutenant has sufficiently gotten his bearings and has shown to some extent what he is made of, and his superiors have had enough time to take a good look at him, can one consider moving him in the direction of that left seat. It is important in this matter not to err in predicting a man's development. For this reason everybody in the unit, from aircraft commanders to senior regimental officers, are encouraged to pay solicitous attention to the young pilots.

But finally the "studying" is completed. And the most promising lieutenants are penciled in as future pilots in command. It is noteworthy that the discussion of candidacies takes place at a general meeting of squadron personnel. This is democratization. Anybody can state his opinion and desires. This is later considered at a meeting of the methods council, where a final decision is made.

The future pilots in command are subsequently instructed according to a special operations training course, which includes training classes one level higher than the currently-held slot, plus independent study, and graded tests. Aircraft and instructors, usually detachment commanders and above, are assigned to the officers.

One of the most important tasks is fully to prepare a lieutenant to perform his future duties by the time the officer is made aircraft commander.

"The general concern with and attention to preparing our pilot in command reserve," emphasized Lt Col N. Kondrushin, "is fully justified. All our aircraft commanders are fairly experienced individuals who on numerous occasions have independently carried out important and critical missions for our country."

Nikolay Mikhaylovich named Capt V. Kirikov, A. Gaponenko, A. Kopasov, and V. Sporyshev, and Sr Lts M. Morozov and M. Zavadskiy as pilots who had been promoted up "from the young ones." Copilot Sr Lt A. Bednov, who is a member of the pilot in command reserve, has already shown good results. His fine flying abilities are obvious to everybody. This is also confirmed by Lieutenant Colonel Kondrushin, who flew with him on a check ride for certification to fly pilot in command day or night.

The people in this regiment are far from overrating the system of democratic selection of young pilots and navigators for promotion. This system still must be put to the practical test. Speaking in figurative terms, they are still planting the field, but they have yet to harvest the crop.

### Getting Rid of an "Achilles' Heel"

Practical military training is becoming increasingly enriched with examples where, for example, tactical air exercise directors place commanders in conditions forcing them to unconventional action and to discard "hackneyed" solutions. One encounters with diminishing frequency instances where ready solutions are imposed. Initiative and innovation are more and more frequently being given free rein. Flexibility of thinking and independence in selection of means and methods of operational training are finding support and approval by the higher echelons. These are welcome signs of perestroika.

"A dynamic nature not only in actions but in thoughts as well is important today," stated regimental navigation officer Maj A. Zhurbelyuk in a conversation with us. "And how could things be otherwise? Today a high degree of professionalism is essential in every field of endeavor, including military transport aviation, for we are called upon to perform important and difficult missions."

That is quite understandable: new approaches are needed in the area of training flight personnel and aviation engineer service maintenance personnel. It is essential to look for and seek out inner reserve potential for genuine intensification of the training process and adoption of modern scientific and technological advances. And all this demands brilliant, talented, dynamic, and bold individuals. Precisely such qualities are to be found in many of the regiment's pilots, navigators, and aviation engineer service maintenance people. They include Navigator 1st Class Major Zhurbelyuk.

When people started talking about computerization as a reserve potential for speeding up the process of operational training, the people in this regiment called this trend an "Achilles' heel." There would immediately follow the clarification that they are trying to eliminate this vulnerability and have placed their hopes on computer enthusiast volunteers.

A computer system was incorporated into the regiment's operational training with the approval and practical assistance of Col V. Kornilov and Lt Cols A. Sorogin and V. Radionov. Aleksandr Grigoryevich Zhurbelyuk is directly in charge of the computer system.

How did it all begin? Patrons—workers at a local plant—donated two Iskra-226 machines. A personal computer was acquired. At first an informal computer room was established in the unit, followed by establishment of a system of data computation, processing and communication to flight personnel. The system consists of interlinked regular flight simulator computer, the Iskra-226 computers, and TV monitor display terminals. The system's principal functions are to prepare flight personnel to perform flight assignments and to ensure flight safety.

What can the system do? A great deal. It automates flight planning calculations for each crew with an individual or common mission and provides a commander with the requisite reference material for making a decision on

carrying out an operational mission. It is also used for specific-purpose flight training drills: flying in formation, flying difficult route segments, emergency situations, and delivering airborne assault forces.

The system's "services" are also invaluable in the area of flight safety. Utilizing flight data recorder tape materials, it can generate qualitative parameters of mission performance, can determine errors, and can rate the performance of each crew member. It can store vast quantities of statistical material on various flight personnel actions.

The computer system is in its third year of operation in the unit. It is very useful. Specific work is currently in progress on writing programs. Scientists from the Military Air Academy imeni Yu. A. Gagarin are being enlisted for this task, for the system's capabilities are virtually limitless.

We have already said what the system can do. Now how about its efficiency? The regimental command element assures us that time required by aircrews to prepare for flight operations has been reduced by 20-30 percent, the reliability of data on aircrew proficiency has increased, and they have succeeded in systematizing the entire flight training process, in pinpointing the most serious bottlenecks, and in improving quality of flight training. Flight crews now prepare more thoroughly for flight operations, utilizing practice programs.

Computerization is more and more persistently entering the training process and becoming a component part. Adoption of computers in Air Force units is frequently impeded, however, for a number of reasons, and perhaps the principal reason is a lack of computer hardware and needed software. It is no simple matter to prepare software; it is a lot of time and bother. Not all computer enthusiasts are capable of writing software. For this reason one and the same question keeps being raised with increasing persistence: "Why not arrange for centralized software development?"

It is hardly likely that the problem of computerization can be resolved by volunteer enthusiasm alone and by gifts from patrons. It is high time to put this business on a planned, orderly basis, in the interests of combat readiness. This is the way the people in this regiment feel.

We should add that they are preparing to install a second computer in the tower. The search goes on.

### The Best in Military Transport Aviation

An attractive certificate and challenge award: a globe with a spacecraft suspended above it.... The regimental aviation engineer service won it last year. Based on work performance, it was rated the best in military transport aviation.

There is a busy time for aviation engineer service maintenance personnel. Training in the regiment is becoming increasingly more intensive, for demands on quality of



training are increasing year by year, and the very atmosphere of perestroyka demands critical analysis of achieved results and motivates one to take an even stricter look at everything that is being done today to ensure the qualitative parameters of combat readiness.

We spoke with Lt Col V. Korobov, regimental deputy commander for aviation engineer service. Viktor Aleksandrovich took over command of the service the year before last. He took over a going concern. His predecessor, Lt Col V. Khaver, left the regiment to take a higher position. They say that he was a specialist with a high level of engineering knowledge and general technical knowledgeability, and that he likes innovation. Korobov has a lot in common with him. "The traditions of our aviation engineer service are such," said Viktor Aleksandrovich, "that we cannot simply aim to maintain yesterday's performance levels. We must go forward. Other criteria and approaches must also be employed."

What does he mean by that? For five years now the regiment has had no aircraft malfunctions due to the fault of aviation engineer service maintenance personnel. A full job of projecting and predicting all possible problems is being done. They have achieved this through efficient and effective utilization of test equipment and by improving observance of correct maintenance sequence and procedures. Specialists 1st Class Maj V. Dadykin, Capts A. Ivanov, V. Fedin, and others are showing a good example in this respect. But nevertheless....

Lt Col V. Korobov is a restless individual and frank in his judgments. He therefore is quite frank about addressing unresolved problems. One such problem which is of particular concern to the aviation engineer service is the fact that at the present time aircraft servicing and maintenance qualitative parameters are not improving.

What is the reason for this?

There is one readily-noted feature: when they want to praise the excellent professional knowledgeability of a given maintenance specialist, the people in this regiment say that he knows the equipment down to the last nut and bolt. Unquestionably this is a very important quality, but in order to achieve it one must not merely thoroughly study the equipment but also have a thorough grasp of theory and the operating principle of all components and systems and their interaction. But even this is sufficient only for narrow specialization, for in today's Air Force, in addition to the customary, and to some extent simple operations, operations which require knowledge of the principles of design, construction and operation of systems of functional linkages as well as thorough knowledge of their physical nature is becoming increasingly more important. Has everybody in the aviation engineer service risen to such a professional level?

Unfortunately we must state that not everybody has. They are aware of this fact in the aviation engineer service, and they are doing everything possible to

enhance the reputation of all aircraft maintenance personnel. Neither procedures discipline nor precise engineering analysis of complex circuitry, nor performance of various adjustment, alignment, and measuring operations as well as prediction of equipment reliability are possible without this.

What is working out well? The methods council has stepped up activities. Its recommendations have become more practical: they are proceeding from daily experience, so to speak. Here is an example.

At an expanded meeting the members of the methods council decided to discuss the utilization of training devices in the form of stand-mounted equipment. Senior engineers and engineers from the subunits were invited to attend. A businesslike, concerned discussion ensued. The tone was set by the keynote speaker, Lieutenant Colonel Korobov.

We should explain something at this point. There is a reason for mentioning the stand-mounted training equipment. This appropriate training equipment was delivered to the regiment. It was placed in a sturdily-built training building. But that is as far as things went. Nobody used these devices. This training equipment, which everybody needed, stood idle due to a lack of 27, 115, and 208 volt power supply. At first this did not bother people much. However, as they say, everything has its limit....

A decision was made at the meeting of the methods council to resolve this "impasse situation." The decision was soon implemented. The training equipment came to life. In addition, actual aircraft systems were brought in and set up. Now there are always a lot of people in the classrooms. Maintenance personnel practice, test one another, debate, and learn.

Efficiency innovators and inventors have appreciably stepped up activities in the regiment. Sixty efficiency innovation suggestions were submitted this past year. The most valuable of these have been incorporated into practical personnel training. They include a remote-controlled inverter-rectifier unit providing various voltages to the aircraft maintenance unit building and ramp, a nose wheel shock absorber sleeve disassembly tool, hardpoint testing panel, nose gear steering system ground testing and adjustment panel, a command signal unit, a set of devices for testing and troubleshooting a high-frequency radio transceiver, a personnel warning system, plus many other items. Their employment is extremely beneficial.

Regiment innovators include Capts V. Bogoyavlenskiy, A. Rudchenko, and A. Novikov, Sr Lt N. Fesenko, Sr WO I. Kuchkin, and others.

The efforts of Air Force innovators have been duly rewarded: substantial monetary awards have been given.

It seems that it is merely necessary to state matters in such a manner that aviation engineer service personnel

have a keen interest in improving quality parameters, see future results, and derive moral and financial satisfaction. This problem is fully resolvable with efficient organization of the training process, a high degree of demandingness, and a conscientious attitude toward the job at hand.

A course of policy aimed at developing independence, initiative, and a creative approach toward accomplishing the daily tasks of operational training is being increasingly consolidated within the regiment. It has been approved and adopted by all maintenance personnel. The results speak for themselves. Since the beginning of the training year there have been no in-flight emergencies due to the fault of aircraft maintenance personnel, there have been no gross violations of proper maintenance procedures, and maintaining the unit's aircraft in a state of good working order is meeting prescribed standards.

#### **We Must Move Faster**

If one assesses the state of affairs from the position of the 19th All-Union Party Conference, however, deficiencies and unresolved problems stand out in relief alongside positive improvements and new developments.

The party committee secretary, a delegate to the 19th All-Union Party Conference, its objective in his appraisal when he states that essentially the efforts of the party organization have in large measure failed to extend beyond maintaining or holding on to achieved levels.

Party members formulate the issue as follows: operational readiness can be increased by achieving high quality of combat training and steady improvement in the job proficiency of personnel. The end of last year was marked by hard work, and the flight training target was met, just as the target pertaining to training young aircrews. Many pilots and navigators boosted their proficiency ratings.

Nevertheless they are forced to admit in the unit that party influence on improvement in end results of combat training remains low. The party committee and party buro frequently are continuing to duplicate the activities of the commanders while not utilizing their political functions. Work is frequently conducted with a narrow group of party members, while many aircraft commanders, detachment commanders, and chiefs of maintenance groups and services remain "out of things," so to speak. Squadron commanders Lt Col I. Zelenskiy and Maj A. Shemuratov correctly state that the party committee and party buros are not reaching such an important category of activists as party group organizers. For this reason no matter how things are boiling at the surface, things are quiet down below, and as a consequence some people develop a sense of irritation, dissatisfaction, and apathy. As we know, various breaches of regulations, errors of omission, and carelessness are born on such soil.

Leader-Communists and party committee members have not yet succeeded in fully overcoming the passivity primarily of the headquarters party organization in matters pertaining to operational training. This results in the occasional occurrence of miscues in planning, personnel becoming separated from training activities, and unnecessary situation simplification. An old pattern sometimes reappears: the attempt to look a little better by overstating performance marks. One cannot say that the Communists in this party organization are not answerable for their deeds and do not bear personal responsibility. Party accountability should be stricter on CPSU members who hold higher positions, however. But in fact this is not always the case.

Matters of combat readiness are inseparable from problems of ensuring flight safety. And it is not surprising that they also occupy the center of attention of the unit party organization. In this regiment for a long time now there have been no air accidents, and one can see a trend toward a decrease in mishap-threatening situations. Party members Ye. Pravdin and S. Proshkin perform their duties conscientiously. The OKZA [expansion unknown] group is doing a good job. Flight recorder tapes and performance-monitoring video tape are available for every crew.

Nevertheless mishap-threatening situations occur. An analysis of these incidents indicates that the regiment has not yet achieved exemplary performance by leader-Communists in flying technique and observing the regulations and procedures prescribed by guideline documents, and they are not sufficiently demanding as regards increasing flight discipline and orderly procedure. Methods council decisions and recommendations are at times vague and unspecific. The party committee notes that the campaign for mishap-free flight operations is not yet being viewed in the party organizations as a multiaspect effort. They endeavor to solve problems with one-time measures. And aircrew party groups frequently are ignored. In the party organization they often fail to try to analyze the cause of a near-mishap incident; instead they look for the guilty party in order to take party disciplinary measures against him and end matters at that. Sometimes the opposite happens, however: not wishing to punish a pilot for a near-mishap incident, they simply ignore it.

We do not feel that such a work style is acceptable. We discussed this point with members of the party committee, and their opinion is as follows: objectivity and an individual approach in handling the matter should be ensured in each instance and toward each individual. We would like to believe that good intentions will be transformed into concrete action. In any case realities and the practical business of perestroika insistently demand this.

#### **"But Problems Remain...."**

The first regimental party meeting this year was devoted to the issue of personal responsibility by party members

for the actual state of unit operational readiness and ways to improve it. Lt Col N. Kondrushin made the keynote presentation. It contained an analysis of the state of affairs, criticism and self-criticism, and formulated tasks for the future.

Aware of the great deal of attention the command element and party committee devote to this problem, one could have expected a high degree of activeness on the part of party members. Those present, however, gave the presentation a fairly reserved response, and those few individuals who took part in the subsequent discussion did not alter the overall mood.

What was the reason for this? In our opinion important issues were being raised.

"Yes, important issues," those sitting next to us agreed. "But for us they are not new. Decisions are adopted, but the problems remain...."

This brief conversation was essentially a repeat of what was stated at a party report and election meeting: "At meetings party members constantly hear appeals regarding the need for an all-out effort to increase combat readiness and professional skills, but the actual situation and practical realities frequently negate this necessity...."

The question of what to use to warn personnel of a practice alert was raised repeatedly, for example. Party members responded. Capt V. Bogoyavlenskiy and Sr WO I. Kuchkin suggested using an aircraft transmitter and regular radio receivers. They tested the system at different frequencies. The experiment was a success. They then developed a signal-recognizing and noise-suppressing add-on device....

There is no need to point out all the advantages of this method of alerting personnel. It was also given approval at higher-echelon headquarters. The enthusiastic inventors asked one of the plants to figure up the cost of manufacturing such devices. It turned out to be quite a substantial amount, and higher headquarters lost interest in the invention.

But the people did not give up. They learned that one can enter into a contract on the basis of which it is much less expensive to order a large number of units at one time than to order several hundred units. There are many takers who would be willing to pay good money for such a device, but as we know, things are not so simple in this matter as well. So things are not moving.

In the meantime there sounded another appeal to increase combat readiness. And once again that tireless human intellect went to work. The new economic relations, economic accountability, and a stewardly good-management approach to things—Maj V. Chmil cited all these factors in support of his proposal. It boiled down to the following: various equipment, for example, is on a manufacturer's servicing warranty. If some instrument fails, let us say, a warranty claim is filled out. The

manufacturer is supposed to pay a monetary penalty, but certainly not Military Transport Aviation. But what if at least part of this penalty payment went for the needs of those who operate the warranted piece of equipment? Perhaps then there would not be a problem with where to obtain money to improve the personnel alert warning system, as well as for many other things.

Or perhaps things are different: the device developed by V. Bogoyavlenskiy and I. Kuchkin was invented quite some time ago and is gathering dust in a storage room, while economic relations between manufacturer and customer are much more complex than V. Chmil imagines. But people do not know whether they are doing something useful or are in error, and they receive no meaningful answer.

Incidentally, there are also no clear answers to many other questions. For example, why is there always a shortage of certain spare parts? Why are flight crews driven out to modern aircraft by truck? Why is it that equipment available to Aeroflot prepares an airfield for flight operations faster and with better quality than the equipment available to a separate airfield technical support battalion? Or take the protective covers which are supposed to keep ice from forming on aircraft surfaces. Sometimes in order to remove them it is necessary to douse the aircraft with hot water or resort to other devices. After all, there is an effective means against icing of aircraft surfaces; just look at Aeroflot.

One can also easily understand airmen's puzzlement over another item: why is it that the patron enterprises which gave them the two computers will immediately obtain new, more sophisticated equipment, while the military transport aviation regiment is happy to receive old computers being retired from service? After such a problem, replacement of obsolete garrison ATS [expansion unknown] might seem trivial to some, but that is not so: everything enumerated above affects unit operational readiness to one degree or another.

#### Who Will Cut the "Gordian Knot"?

As we know, waiting for any commission is not the most pleasant thing. But for the children of this airbase the arrival of high-ranking visitors or inspecting officers is connected with a unique amusement. On the eve of a visit, runway-surface ice-melting trucks work from morning to evening cleaning and drying roads on the base. The fountains of mud thrown up by the jet engines is indeed a unique spectacle. You can tell for sure: since the TMs [teplovaya mashina] are at work, you can expect visitors.

The regiment is under various jurisdiction by several "agencies," and there is no shortage of commissions and inspecting officers.

This has been going on for years, but the scattering of administrative jurisdiction is hindering efforts to repair roads, lay asphalt, and to renovate and spruce up facilities and housing.

The situation is particularly bad with housing. The basements contain standing puddles and pools of water, and water leaks in through ceilings and walls. Both children and adults, including aircrew members, frequently fall ill due to the constant dampness, especially on the lower floors. This naturally affects operational readiness.

Yes, water is "encroaching" from below and above. And yet in every washroom, alongside enameled washbasins and nickel-plated faucets one finds old-fashioned simple cast-iron washstands. We have seen such fixtures in arid regions, but it was puzzling to see them here, on a base located right alongside one of our great rivers.

As paradoxical as it might seem, it is a fact that with an abundance of water it frequently becomes a short-supply item, since the water lines and sewer system do not work well. The system has deteriorated to such a state that the chairman of the most recent military district commission said: "It would be easier to build a new base compound and all new utility lines than to rehabilitate the old ones." And yet time goes on, the old system is crumbling, but no new system is being built.

The chairman of an Air Force commission advanced from word to deed and arbitrarily ordered all public toilets on the base shut down. Aside from the legal aspect of this order, in this instance one would be hard put to say what was worse: inaction or actions of this kind.

In any case, this vitally important problem at the base has not yet been resolved. It is high time to cut this "Gordian knot." But the question is: who is to do it? For the time being it is considered that repair of utility and service lines, as well as of roads and buildings, should be handled by the separate airfield technical support battalion. It is quite clear, however, that the battalion lacks the resources, materials, and specialist personnel for these activities. Incidentally, specialist personnel are available. One of them, driving a TM, dried up a huge puddle by the base gate. We left the base to the roar of the jet engine, filled with mixed feelings. On the one hand we felt profound respect for people who are selflessly carrying out their party, military, and civic duty, and with admiration for the modern aircraft and on the whole for the fusion of the human and technical factors, which comprise enormous potential. On the other hand we had feelings of anxious concern and worry about the problems existing alongside. We do not believe that things can remain in balance. Victory must go to perestroika.

COPYRIGHT: "Aviatsiya i kosmonavtika", 1989.

### **Fighter-Bomber Regiment Trains at Tactical Range Facility**

91441288c Moscow AVIATSIYA I KOSMONAVTIKA  
in Russian No 4, Apr 89 (signed to press 14 Mar 89) p 8

[Article, published under the heading "For a High Degree of Combat Readiness," by Military Pilot 1st Class Maj B. Kononenko: "He Went Out to the Range, But What Did He See?"]

[Text] The squadron tactical air exercise was entering the final phase. The fighter-bomber pair led by Military Pilot 1st Class Maj A. Mikhno reached the target area and, spotting a mock-up of a surface-to-surface missile, accomplished its strike on the first pass. The tapes confirmed highly-accurate weapons delivery.

The difficulty of the mission was dictated by the fact that target search and destruction had to be performed on the tactical range. As a rule this puts pilots in a difficult situation, for the target may be located at any point within a rather large area. After penetrating the "hostile" air defense zone and reaching the search area, one must quickly find the target, identify it, execute a maneuver, and carry out the attack. In addition, it is important promptly to communicate the target's coordinates back to the command post.

"Major Mikhno's two-ship element accomplished all this successfully," said the regimental commander. "This is why the results are gratifying."

Much is done in the unit to ensure that aircrews steadily improve their combat flying proficiency, their piloting ability, and their weapons delivery skills from one sortie to the next. Younger pilots flew wing to wing, so to speak, alongside veteran pilots, assimilating experience and know-how from the latter.

A flight training schedule is displayed in the methods classroom. Many squares are filled in opposite the majority of names, indicating plan fulfillment.

There are examples of another kind, however. For example, the pair led by Capt Yu. Prisyazhnyy failed to destroy its target.

I asked deputy regimental commander Lt Col V. Garkusha how many times the tactical range was used in the process of flying simulated combat missions.

"Not too often," he admitted, and added: "That is why Captain Prisyazhnyy failed to accomplish the mission."

I must state that the necessity of moving the tactical range into the practice area was dictated by difficulty in utilizing the permanent air-to-ground range, for the pilots of other units also have to improve their weapons delivery and tactical proficiency. There is a range utilization schedule approved by the higher commander, but it is sometimes not observed. There are many reasons for this. One reason is rigid scheduling. If it was not possible to use the permanent range today because of bad weather, tomorrow there may be no opportunity. For this reason regimental brass resorted to the tactical range as an alternate possibility.

But the effectiveness of pilot activities with the temporary range facility proved to be not too good.

First of all, the regiment has been using it only fairly recently, and during the winter period of training it was used only four times in the course of scheduled flight

operations. Secondly, the pilots were unable substantially to improve their tactical proficiency because some supervisor personnel allowed excessive situation simplification. Maj V. Bovshenkov, for example, regimental air, weapons and tactical training officer, in order to make things easier for the aircrews, gave orders to set up the range facility near a road fork—the most readily-identifiable landmark in the search area. Thus the pilots were given truly “hothouse” conditions which were far from conditions in an actual combat environment.

The fundamental principle “teach troops that which is needed in war” is frequently discussed at meetings and conferences. Unfortunately it is not always observed in actual practice. Restructuring of flight training methods taking into account the requirements of modern combat is presently proceeding slowly and with difficulty in some subunits. But today it is not enough to acknowledge that there were shortcomings in the past. It is essential to set up the training process in such a manner that it maximally helps raise the level of combat readiness and proficiency of aircrews.

Things are well arranged, for example, in Lt Col A. Antonovich's subunit. The matter of pilot tactical proficiency depends directly on meeting the combat training schedule. Officer-leaders, from flight commander on up, make use of each and every sortie to increase the pilots' tactical skills.

I watched as officer Yu. Tsurulnichenko gave each pilot an assignment for a training flight into the practice area, incorporating elements of tactics into the assignment. In particular, he required that they consider the placement of the sun and clouds in case they had to engage in air-to-air “combat” while attacking a ground target. Holding a model “enemy” aircraft, he demonstrated various countermeasures. Thus the pilots became accustomed to seeing threat aircraft in various situations and at all aspects and to making intelligent decisions in a prompt manner. Subsequently it became a customary activity for the pilots to do tactical training alongside working on the principal flight training assignment.

Considerable opportunities for this are offered by the tactical range, in utilizing which one can run through various situations, maximally complicating aircrew combat training activities. As practical experience indicates, it is important to seek to ensure integration of the process of flight training and tactical training in the subunit.

One can state that if the range is not always utilized in a methodologically intelligent manner in the subunit, how can one explain the successful performance of Maj A. Mikhno? In my opinion the answer lies in the element leader's considerable professional experience (he had served a tour of duty in Afghanistan).

The following conclusion suggests itself. In view of the kaleidoscopic swiftness of change in the tactical situation, combat pilots should continuously be trained in making intelligent decisions in the shortest possible

time. And elimination of excessive attention to form with consequent detriment to content in the process of combat training, and in using the tactical range in particular, will make it possible to avoid many mistakes.

COPYRIGHT: “Aviatsiya i kosmonavtika”, 1989.

### Using Music to Boost Effect of Physical Training Classes

91441288d Moscow AVIATSIYA I KOSMONAVTIKA  
in Russian No 4, Apr 89 (signed to press 14 Mar 89) p 9

[Article, published under the heading “At Air Force Higher Educational Institutions,” by Lt Col V. Ivanov, candidate of psychological sciences: “Using the Medium of Sound”]

[Text] It has been proven and acknowledged that music influences the effectiveness and efficiency of human activity. And during the last 5 years we have been utilizing this amazing and wonderful phenomenon in flight school cadet physical education.

We know that even the most favorable light and color environment soon loses its positive effect and begins to be perceived as a monotonous irritant. In order to avoid this it is essential to bring it into conformity with the cadets' specific current activities in regard to rhythm, intensiveness, and intensity, that is, we must create a favorable environment, and this means making it dynamic.

One can obtain a dynamic sound and color environment by various means. We chose the creation of special functional zones. We proceeded from the position that one group of colors (red, yellow, green), in combination with fast-tempo major-key music, has a stimulative effect on the system, while another (all shades of blue), in combination with soft, minor-key music, has a calming effect.

We set up the gymnasium taking into consideration the functional influence of various color combinations.

But I would particularly like to share our experience in using the sound environment. It was purposefully created with the aid of a special selection of music. We used recordings of those melodies which the cadets like. We used performances both by Soviet and foreign groups, bands and orchestras.

Our selection included songs written by Soviet composers specifically for pilots, as well as athletic marches. We provided musical accompaniment to training classes with a record player, amplifier, and speakers. The equipment was operated by a special soundman-instructor.

Physical training classes with an organized sound background commenced in November, when climatic conditions make it necessary to move into the gymnasium. Things continued this way until the end of March, when the weather permitted physical training to be conducted

outdoors. The work was organized in a well-planned regimen, integrating movement and music into a single harmonious whole.

For a period of 10 minutes prior to a physical training class, music would be played in the gymnasium, the purpose of which was to get the men into a good, emotionally positive mood and to relax emotional stress occurring as a result of adverse environmental factors. Most frequently we played the "Physical Culture March" by I. Dunayevskiy and a march based on themes from the movie "First Glove."

Music with a clear-cut rhythmic pattern would be played at the beginning of the preparatory part of the class. Cadets would perform drill exercises for between 2 and 3 minutes, to the accompaniment, for example, of I. Dunayevskiy's theme from the movie "The Goalie" or M. Blanter's piece "Under Our Athletic Banners." This would be followed by 10 minutes of running to the rhythm of musical accompaniment. During this time the music would lead the cadets, to which the latter would adjust the rhythm of their running motion. During this phase of the class we would use pieces by John Lennon and Paul McCartney ("Obladi-Oblada") and K. Breykburg ("Cosmic Sleep").

After running, the squad would form up in a column of fours to the accompaniment of V. Solovyev-Sedoy's cheerful "If You Want to Be Healthy." In this part of the class general developmental 16-count exercises would be performed to the accompaniment of music by V. Miguli ("Grass by the House") and Yu. Antonov ("Long-Awaited Plane"). Combined drills would be accompanied by pieces by S. Namin ("Carousel") and D. Maruani ("The Blue").

During the main part of the class the squad would perform the curriculum-specified volume of physical exercises (gymnastic and specialized). "Enchanted Flight" (by the group "Space") and "Music of the Cosmos" (by the group "Zodiac") were used as mood-contributing factors.

At the end of the class the students would spend between 2 and 3 minutes on breathing and relaxation exercises. A light routine not requiring particular exertion would be used. During this time soft melodic music would be played, organically combining with breathing and relaxing motions, such as Claude Debussy's "Clair de Lune" or "Improvisation" by R. Pauls.

Cheerful, mood-inspiring music ("Our Olympiad Out Front" by I. Luchenko, "To the Glory of Life" by M. Blanter) would accompany the students to other class activities.

In conducting training activities with cadets in the first through third years, we endeavored to help raise the level of development of physical and esthetic qualities and improve the system's functional capabilities. With this aim in mind we somewhat increased the duration of the

preparatory segment by introducing 15 minutes of running and elements of rhythmic gymnastics. Students would perform rhythmic dance movements to the accompaniment of contemporary rhythms (by the group "Bobby Sox").

A brief instructional session on the specifics of performing gymnastic and dance movements would be given in order to ensure more conscious and aware assimilation of the exercises. The students' attention was drawn to the independent nature of searching for assimilable, original, and attractive forms of movement. The students were oriented toward performing movements which would maximally foster beauty of execution.

After such classes students show ability of self-mastery and an endeavor continuously to lead a high-intensity lifestyle.

Results of a psychological-pedagogic study indicate that the volume of exercises performed at a class using musical accompaniment exceeded by 33 percent that of classes without music. And, what is very important, increase in the volume of exercises caused a 32 percent increase in functional indicators in the students at various points during a physical training class.

As a rule flying activity is characterized by a high intensity of psychomotor actions and sensory-perceptive processes, by the necessity of rapid processing of information, and by moments of high attention concentration. One can therefore understand the extraordinary importance of utilizing a sound environment in physical training. This is an indispensable means of activating a person's mental and emotional functions and mobilizing one's latent potential.

Efficient alternation among various kinds of motor actions against the background of a specially-formed sound environment fosters in the students a feeling of satisfaction and esthetic enjoyment from the realization of their abilities. Principles of harmony of sound and motor coordination are engendered and developed on this foundation, principles which are capable of linking power of physical movement with esthetic proportionality. Contact with a dynamic sound environment and its perception include cognition of the new in life, of oneself, as well as self-education. It also includes instilling a sense of implacable opposition toward everything negative: in conduct, external appearance, and the everyday living environment.

It follows from this that a well-organized environment exerts stimulating influence on psychological functions, on the state of the central nervous system, and on the students' work efficiency as a whole.

Our department's faculty have become convinced through our experience that the proposed methodological approach optimizes conditions of conduct of training classes and makes it possible at the same time to

perform a greater number of tasks and to obtain results which promote achievement of the main goals of flight training.

The above-discussed methods of employment of a sound environment do not exhaust the range of practical tasks and possibilities. We have only begun the discussion. We leave continuation of this discussion to our colleagues of like mind and to those who think differently.

**From the Editors:** One interesting aspect of the problem raised by the author in this article would seem to merit attention. We are talking about utilization of the wealth of possibilities offered by the national and ethnic music of the peoples of our country. The esthetic and psychological effect of the sound environment on the effectiveness of physical training classes will increase to an even greater extent if the specific ethnic composition of military units is precisely taken into account.

COPYRIGHT: "Aviatsiya i kosmonavtika", 1989.

### **Prevention of Dangerous Incidents and Air Accidents Discussed**

91441288e Moscow AVIATSIYA I KOSMONAVTIKA  
in Russian No 4, Apr 89 (signed to press  
14 Mar 89) pp 10-11

[Article, published under the heading "Flight Safety: Experience, Analysis, Problems," by Candidate of Military Sciences Col V. Dudin, inspector, Air Force Flight Safety Service: "Preventing Air Mishaps"]

[Text] In the new training year military aviators are carrying out their assigned tasks with primary focus on qualitative parameters. Herein lies the basic difference in the combat training process from past years when, for the sake of "his majesty" percentage of fulfillment of the total hours logged target, number of weapons deliveries, gross figures on increasing proficiency ratings, plus other numerical data, many important indicators of actual rather than on-paper Air Force personnel preparedness were ignored.

Flight safety is among the most important components of quality not only of combat training but of daily Air Force unit activities in general. Anybody who has experienced an air mishap or tragedy remembers for years both the tragic moment itself and the inevitable string of grave consequences following it: loss of military comrades, loss of expensive hardware, and infliction of profound emotional trauma on the victims' families. In addition, a tense, stressful situation generated by investigation of the incident, disturbance of the smooth, established rhythm of flight operations, punishments, and sometimes personnel changes from top to bottom as well are inevitable. In short, the echo from an accident generally sounds for quite some time.

Prevention of aircraft accidents should be given prime emphasis in order to avoid these things. Nevertheless at various conferences devoted to problems of flight safety

and when organizing flight operations shifts one frequently hears the opinion that prevention of air mishaps is a contrived term. The claim is made that there are documents which regulate every step taken by a pilot, navigator, engineer, technician, or any other specialist. If these documents are observed to the letter, there will be no accidents. Those which happen anyway are a consequence of unfortunate miscues. Hence the numerous directive demands: strengthen, improve, tighten accountability....

Unquestionably a pilot's personal preparation, efficiency and follow-through are of great importance in achieving flight safety. The complexity of the actual interaction of these two factors with other elements of the "pilot-aircraft-environment" system, however, substantially broaden the causality of many air mishaps, which in the course of their investigation many times do not fit within an unambiguous framework: lack of pilot preparedness or pilot indiscipline.

A certain fatal airplane crash is typical in this respect. The aircraft was initiating a landing approach. The pilot, receiving the necessary landing instructions from the tower controller, correctly read the instructions back but then made one mistake in passing them on to other crew members via intercom. For one digit contained in the landing approach instructions he said another number, similar in sound and more commonly encountered during preceding flights out of their home field and elsewhere. This proved sufficient to introduce a substantial error in the landing approach, which was being made at night and without any lights along the flight path to serve as points of reference. As a result the aircraft flew into the ground even before turning final.

The investigation of this incident indicated that a coincidence of several factors which complicated the final phase of the flight (not their home field, night, lack of lights to provide ground reference, hilly terrain), in combination with a basic error (although both the pilot and all crew members were highly proficient, flew regularly and were highly disciplined both in the air and on the ground) brought the crew to a hazardous situation which ended in tragedy.

Unfortunately such incidents, which follow, so to speak, from negative elements of the human factor, are no exceptional occurrence in flying, either here or abroad. In spite of improved aviator training, increased demands on observing flight procedures, and refinement of flight procedures documents, air mishaps cannot be totally eliminated by these methods alone.

What is the problem? Prevention of air mishaps, as an aggregate of measures supplementing current organization of flight operations, follows from an analysis of air accidents. Thorough investigation of fatal crashes, air mishaps and in-flight emergencies as well as consideration of the aggregate of their causes and circumstances furnish highly characteristic conclusions for substantiation of prevention efforts.



Every year, for example, on the average only about one third of all air mishaps are due to adverse factors in the condition and status of the aircraft or supporting equipment as well as in the environment in which the aircraft is operating, that is, objective causes as regards the pilot. In all other cases the pilots could have either entirely prevented occurrence of the emergency situation or could have prevented it from developing into more serious consequences. This was hindered, however, by a lack of information as well as a lack of recommendations on how to proceed in a given emergency situation. In my opinion formulation and adoption of such measures constitutes the essence and substance of preventing air mishaps.

In spite of the fact that the term prevention has long been used in documents pertaining to flight safety, its organizational basis, and particularly its methodological content, presently leave much to be desired. There are two areas of lag behind the requirements of the present day, each of which diminishes the effectiveness of preventing air mishaps.

First of all, formulation and statement of methods of prevention as a rule apply to military aviation as a whole, without considering the specific features of aircraft utilization at each level of the existing organizational structure. The principal levels include the central directorates, Air Force headquarters staffs, unit and subunit leader personnel, and flight personnel proper.

Each of these levels has its prerogatives, its capabilities, and its relationship of interest in respect to flight safety, and these are far from identical. While for higher-echelon officials, for example, who deal with overall accident statistics, prevention is characterized by gross data (decrease or increase in total number of air mishaps), it is obvious to the pilot in the regiment that the very first serious professional error may prove to be the last in his flying career, if not worse. For him the theoretical and probability aspects of prevention are not of mass relevance—what he needs to do is prevent that one single accident and save his aircraft and his own life.

Secondly, the majority of existing documents, recommendations and other materials pertaining to prevention for the most part explain its importance, end aims, principles, and other conceptual elements. The forms of practical measures, however, and methods of adopting advanced know-how, especially at the "regiment-pilot" level, are poorly elaborated.

This is why it is very important also to channel an applied thrust to prevention. What we need are specific recommendations on what should be done in an air regiment of a specific air component (including each individual pilot) and how it should be done in order to prevent the most typical air mishaps which occur more frequently with aircraft of a given type under similar stationing conditions. In other words synthesized experience is essential.

Analysis of accident statistics incontrovertibly attests to the fact that the majority of air mishaps follow one another in a given Air Force unit. The mechanism of occurrence of emergency situations and the dynamics of their development are almost entirely alike. Obviously such unfortunate experience should not have like incidents continuously added to it but should be immediately transformed into preventive measures.

Of course at all higher echelons, from command and inspector personnel of combined units to the central directorates, each air mishap is scrutinized, adverse trends in specific types of flight training are analyzed, and the most diversified measures are formulated: from adjustment of training courses to aircraft operation and adoption of restrictions on performance of certain maneuvers in routine and combat flying.

This prevention "from above," however, shows a certain degree of inertia. There is considerable delay before measures adopted at the central level reach each individual pilot. In addition, prevention by instructions from above sometimes leads to certain collateral negative phenomena which were not taken into consideration when substantiating specific measures (for example, excessive situation simplification or a sweeping approach, the consequences of which become evident considerably later). Precisely for this reason prevention of air mishaps at the level of each Air Force unit should have an independent, active directional thrust. It is high time to reject complacency, the attitude that everything is fine since instructions from the higher echelon have been carried out. Such commanders should realize that central headquarters cannot take into consideration all the finer nuances which can occur in the units.

What methods should be used to influence prevention of air mishaps in the Air Force regiment?

Training activities with personnel—from lecture classes and group training classes to practice drills and training simulator practice sessions—without question comprise the bulk of preventive measures which are most amenable to planning, scheduling, and systematic implementation. As an aggregate they make it possible to maintain and increase the knowledge and skills of Air Force personnel of all areas of specialization, make it possible to prevent the development of emergency situations, and help formulate a correct response when an emergency situation arises for any objective or subjective reasons.

During organization and especially during conduct of training activities it is extremely important to avoid a lip-service attitude, which is rather widespread in this area of activity, and an endeavor to carry out absolutely all requirements and recommendations of guideline documents and informational reports pertaining to flight safety, without priority emphasis on those topics which are most relevant to a given unit. Practical experience indicates that gross quantitative emphasis does not produce effective results.



For this reason it is necessary to determine a list of the most typical air mishaps, for the prevention of which one should collect materials, textbooks and manuals for all types of training activities (diagrams, flight data recorder tape analyses, recorded radio communications in emergency situations to be played in class, etc). Such lists, which determine both priority and periodicity of conduct of training activities, will unquestionably be specific for the air regiments of each air component.

For fighter regiments these should primarily include air mishaps connected with stalling out during aerobatic maneuvers due to threatened collision when changing configuration in formation flying or with the target aircraft during practice intercepts. Mishap situations for fighter-bombers would include weapons delivery at the air-to-ground range (stalling out when turning to final target heading and during maneuver following ordnance delivery, late recovery at too low an altitude, and as a consequence of taking damage from fragments). For reconnaissance aviation situations would include maneuver in the reconnaissance target area, and particularly during processing of data, shifting from terrain to map, and operation in instrument meteorological conditions.

While not denying the importance of generally-accepted analysis and prevention of the causes of air mishaps, this approach to preventing specific variations of emergency situations is also fairly valid. Of importance to a pilot who gets into a hazardous situation is not only its cause (coincidence of deficiencies in planning the flight, errors by the tower controller, pilot error, equipment failure), but particularly the content and sequence of actions which will prevent a worsening of the situation. Without such an approach recurrence of the same negative results will be inevitable. This is precisely what happened in the tragedy described above: a similar emergency situation had repeatedly occurred with other crews during the same flight phase.

Organizational-methods instructions on combat training specify the procedure and sequence of conduct of special flight safety classes as well as the directional thrust of measures to prevent the most common breaches of regulations. But the sequence and specific purpose of these training classes is the concern of the command element of each air regiment, which must classify typical air mishaps according to specific features, rather than reducing everything to a mere reading off of bulk information on a large number of various incidents, some of which are totally irrelevant to the aircraft being flown by the regiment and the specific features of the current season.

Emergency procedures drills also require similar preliminary evaluation for relevance. Dozens of in-flight emergency situation variations are described currently in the operating manuals of aircraft of specific types. The probability of their occurrence and actual danger are far from identical. A lip-service conduct of training drills without considering actually-occurring incidents also

fosters recurrence of emergency situations which does not gibe with averaged-out probability estimates.

During winter training, for example, in-flight emergencies connected with engine air intake icing recurred in the air regiment with which officer V. Nedostupenko serves. Last winter it was ascertained both that there was an air intake design flaw, an error in the section of the aircraft operating manual dealing with preventing engine intake icing, as well as deficiencies in estimating degree of icing. But until these interlinked factors were resolved, no effort was undertaken to refine aircrew procedures when such situations arose. And yet this was being taken into account in other units flying the same aircraft! This is the cost of lack of independence on the part of the unit command element.

Monthly evaluation of the current state of flight safety and requirements for ensuring flight safety is very important for determining the content and sequence of measures to prevent air mishaps. It is organized by the unit command element with mandatory participation by sub-unit commanders and chiefs of services. Independent of the form such a discussion could take, such as in the course of determining performance results or at a meeting of the methods council, it enables one to determine the most important goals and methods of prevention for the forthcoming month, grounded on collective opinion.

I should like specifically to discuss the insufficient effectiveness in many instances of such a traditional preventive method as maintaining records on and analysis of air mishap-threatening situations. One still encounters primitive assessment of the state of flight safety in a given regiment on the basis of total number of accident-threatening or near-mishap incidents. Competing units juggle such evaluations particularly glibly (in spite of the fact that they understand the flaw of such an approach as well as a clearly-marked endeavor to isolate from the entire aggregate of causes of an accident primarily the culpability of personnel, especially flight personnel). This flawed practice fosters numerous instances of covering up mistakes. The actual state of affairs in the unit is distorted as a result, and there is failure to monitor the accumulation of genuinely dangerous trends. Is it so surprising after this that a serious air accident involving gross violations of flight procedures frequently takes place precisely in a regiment with few near-accident or mishap-threatening incidents?

Obviously greater specificity of the task pertaining to ensuring flight safety during the training year for each of the basic levels—pilot (aircrew) and regiment—would promote increased effectiveness of preventing fatal accidents and non-fatal mishaps, the lack of which (rather than lack of mishap-threatening or near-accident situations) genuinely characterizes the quality of preventive measures.

The following could be one variation. A pilot performance achievement target would be not to have any

dangerous accident-threatening incidents during the course of the year for which he would be at fault, plus intelligent, knowledgeable response in the case of in-flight emergencies due to other causes. The target task for the Air Force combined unit would be to reduce the mishap rate this year in comparison with last year.

Everything is interlinked here. If a pilot does not by his own culpability cause a dangerous accident-threatening situation, this means that he will also not approach the boundary of an emergency situation. An in-flight emergency certainly can occur for other reasons—due to equipment failure, tower controller error, etc. By precisely knowing and maintaining correct skills in such situations, however, the pilot should counter the development of an in-flight emergency.

There is another criterion for the Air Force regiment. It makes no mention of mishap-threatening incidents let alone number of such incidents: an absence of air mishaps and in-flight emergencies due to the fault of personnel is of determining significance....

Unquestionably there also exist other methods of preventing air mishaps. Combining methods should help substantially improve the quality of combat training.

COPYRIGHT: "Aviatsiya i kosmonavtika", 1989.

### Faulty ATC Procedures Cause Midair Near Misses

91441288f Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 4, Apr 89 (signed to press 14 Mar 89) pp 14-15

[Article, published under the heading "Flight Safety and the Human Factor," by Lt Col A. Medenkov, candidate of psychological sciences, and S. Rysakova, psychologist: "Can Potential Collision Situations Between Aircraft Be Prevented?"]

[Text] Statistics indicate that the number of violations of air regulations and flight procedures, near misses between aircraft, and air accidents remains approximately the same from one year to the next. The numerous services and agencies involved in determining the causes of airspace conflict situations frequently cite the human factor. We shall endeavor to trace this linkage with examples.

\*\*\*

The pilot of an An-22, cleared to proceed via a direct route, deliberately flew other than as cleared. The pilot of a MiG-21, flying a landing approach in the pattern, delayed turning from base to final and ended up on a final approach path used by civil-aviation aircraft. The pilot of a MiG-23, following ground controller instructions, failed to follow prescribed departure climbout acceleration procedures and crossed an airway. The cumulative result of these mistakes was dangerous near misses and a threat to flight safety.

Generally the following are listed as the primary causes of such situations: lack of coordination and errors of omission in procedures by aircrew and ground controllers, irresponsibility on the part of these persons, lack of discipline, and inadequate job proficiency. In each specific instance the airspace conflict situation is analyzed and administrative conclusions are reached regarding the guilty parties. Are these measures effective?

Yes, if one considers the dynamics of the total number of violations of air regulations and procedures and near misses taking into account the steady increase in air traffic. But the answer is no if one assesses the number of incidents caused by diminished reliability of air traffic control taking into account the moral, economic, and social detriment they cause.

Practical experience indicates that preventing erroneous, untimely and and less than optimal actions by air traffic control personnel is an effective way to increase air safety. Of course this is true only if it is grounded on knowledge of the actual causes of unreliable human performance.

Why did an air traffic controller prove to be unprepared? How is it that an undisciplined officer was allowed to work in air traffic control? What causes diminished motivation and alertness in air traffic controllers? One can provide an answer to these questions only if one understands the psychophysiological reasons for a person's mistakes. From this position he can be helped to do a reliable job.

Forgetting information, hearing information wrong, an incorrect picture of the current and projected situation—this is a far from complete list of the psychophysiological reasons for those actions which are frequently interpreted as indiscipline and irresponsibility. Such conclusions result in appropriate disciplinary measures. Are they effective?

Let us examine in greater detail near-miss incidents occurring due to faulty, untimely, and less than optimal actions by ATC personnel.

...It was a hot day in July, with few clouds. As usual, civil aircraft were flying the airways. And military pilots were practicing their skills in specially-assigned areas. The ATC en route controller was in radio contact with 11 aircraft. The duty military air traffic monitoring officer's schedule showed a flight by a two-ship fighter element. The time and place at which they would cross the civil airway at an altitude of 9,600 meters were noted.

A Tu-134 aircraft at flight level 9,000 meters proceeded to occupy the en route controller's attention. When the aircraft called in at a mandatory reporting point, the controller gave it a new heading and instructed it to climb to 9,600 meters. Four minutes later the Tu-134 pilot reported level at 9,600 meters. Twenty-five seconds later he reported two fighters crossing his path at that flight level.

The operations duty officer was guiding the fighters blind, so to speak. There were no returns on the radar. The fighters' departure had been delayed an hour. In addition, following takeoff the fighters deviated somewhat from their departure route, but the military controllers did not consider this significant.

The Tu-134 pilot's report of a near miss with the fighters took the en route controller so much by surprise that he took it to be a report by another aircraft flying at 10,800 meters. Only after verifying the aircraft's callsign did he grasp what had actually happened.

We can trace the following chain of poor coordination. The en route controller's actions were based on his assumption that the fighter pair had already crossed the airway and that the Tu-134 had passed out of the zone in which civil aircraft were prohibited from flying at flight level 9,600 meters. In fact all this differed from the events which were actually taking place. The fighter departure had been delayed and, deviating from their designated course, they had crossed the airway outside the restricted area. At this time the Tu-134 was being vectored by the en route controller onto the airway.

Why did the duty military air traffic monitoring officer not have a full picture of the air traffic situation? Because the military controllers had failed to pass on to him the information that the fighters had deviated from their designated route. The radar return from the fighters failed to be identified on the radar screen. The en route controller in turn did not have a full picture of the air traffic situation because he had not been informed of the fighter departure delay and that they had deviated from course. His scope showed no radar returns from the fighters.

As we can see, each individual action by the en route controller and the military air traffic monitoring duty officer did not of and by itself present a threat to air safety. But only if there was no interlinkage between actions. Both of them believed that, with air traffic proceeding as scheduled, their actions were correct. Neither of them even considered the possibility that a problem might occur.

According to air traffic control procedures, when ATC approves a change in altitude, it should have a clear picture of the current air traffic situation. But in fact many times these requirements are not observed. What is the problem?

In analyzing this specific situation, the simplest thing is of course to conclude that the air traffic controllers simply showed an irresponsible attitude toward prescribed procedures. But do measures unequivocally excluding the possibility of the recurrence of such an incident proceed from this conclusion? They do not, because inadequate assessment of the air traffic situation frequently is a consequence of deficiencies in providing full information to the en route controller and airspace monitoring duty officer.

These deficiencies are connected both with the technical equipment of control agencies and with the finer points of interaction among air traffic control personnel. If the radars had shown returns from the Tu-134 and the fighters and if accurate information had been available on their altitude, the airspace conflict situation could have been foreseen and resolved without endangering flight safety. If the operations duty officer and en route ATC controller had informed one another about changes in the flight plans of the fighters and the Tu-134, their actions would have been different.

Personality features of the en route controller and operations duty officer also may have played a role. It has long since been noted that self-assured or, on the contrary, shy, uncommunicative individuals do not feel any particular desire to inform others about their intentions. This may be why the ATC en route controller, for example, failed to report his actions pertaining to vectoring the Tu-134 onto the airway.

Unfortunately not all air traffic control specialists possess the ability critically to evaluate not only the effectiveness of their own actions but also the inevitable diminishing of functional capabilities with age. They fail to notice that as the years pass they become less alert, slower, and more forgetful. And when pilots begin asking follow-up questions and reminding them about something, they do not always respond properly. This results in injured feelings, irritation, a disinclination to communicate, or to communicate any more than necessary, even to resolve legitimate items. All these are realities one must bear in mind.

Shortcomings connected with interpersonal relations and a lack of confidence in and respect for one another can adversely affect air safety. This is why matters of psychological support of air traffic control specialist personnel activities are so important.

It is known that as much as 26 percent of near misses occur due to lack of coordination in air traffic control actions. What does the above-examined incident indicate, for example? First and foremost it attests to the need mandatorily to provide air traffic control personnel with information enabling them to make a prompt, timely and objective assessment of the air traffic situation. This is confirmed, incidentally, by the following incident.

A MiG-21 pilot, executing the instructions of a duty shift tower controller, crossed an air corridor not in level flight as regulations require but while climbing. As a result he had a near miss with a descending An-24. One factor contributing to this situation was the fact that members of the air traffic control team were unable to monitor air traffic, because the ATC radar displays were out of adjustment and focus. And what is the point? The air traffic control team's actions were judged to be wrong. The guilty parties were determined, and that is the end of it. And yet one important question remains

unanswered: were these persons provided with an adequate volume of information required for making a decision appropriate to the situation?

Both in this case and in a number of other cases it is difficult unequivocally to determine the reason for the incorrect actions by air traffic control personnel. For example, a controller clears an An-12 to climb to 7,200 from 5,400 meters, passing through 5,700 meters, an en route altitude to which a Yak-40 has been assigned. Let us assume that the ATC controller has been working unsupervised for less than a month. In such situation as a rule everything is attributed to his inadequate degree of training. Such a cavalier attitude toward the causes of dangerous air situations creates the impression that there are those who would simply prefer to sweep such incidents under the rug as quickly as possible. In the meantime unresolved problems keep piling up....

Why did the controller make a wrong decision? Had he forgotten the regulation prohibiting climbing when crossing an airway? Was he unaware of the aircraft's location? An analysis indicated that the latter reason is the most probable. There was clutter on the radar display, and therefore the controller could not clearly see the position of the An-12. Without having determined its exact position, he issued clearance to climb to another flight level at a time when the An-12 was approaching the airway intersection point.

Sixty-nine percent of midair near misses are due to an inadequate picture of the air traffic situation by air traffic controllers. Here is another example.

It was a morning in June. Visibility was 20 km. Two aircraft—a Tu-154 and a MiG-23, flying at an altitude of 10,800 meters, barely missed colliding, one passing 20-30 meters below the other. The duty controller had cleared the Tu-154 to fly at 10,800 meters... 2 minutes prior to the incident. The radar display showed no return from the MiG-23, and therefore the ATC controller lacked a correct picture of the traffic situation. In what way is he to blame in this incident? Let us analyze the conflict situation.

The duty controller had been informed of the restriction on flying at flight level 10,800 meters on the airway in question. Nevertheless he cleared the Tu-154 to that flight level 30 minutes prior to the incident. What was he thinking? His reasoning was that the MiG-23 had not taken off on schedule and therefore the restriction on flight level 10,800 meters had been imposed prematurely. For this reason he began to discuss the already-made decision with the shift supervisor for... 11 minutes! Even if clearance to pass through the airspace in question had not subsequently been given, it was already virtually impossible to change anything.

Why had the shift supervisor given approval? In our opinion it was primarily due to lack of sufficient information.

People are human, regardless of their job or position. A person makes decisions in the belief that he is objectively assessing the situation developing at a given moment. And since departure is sometimes delayed, and information on departure usually comes in immediately, the controller's decision would appear to be quite natural.

Let us summarize. What directions to be taken in order to improve air safety proceed from analysis of the psychophysiological reasons for faulty, untimely and less than optimal actions by air traffic control personnel?

Effect on the personal factor. It is necessary to teach people to check and recheck themselves, to teach responsibility, constant alertness and to think before acting. Such measures are most frequently taken according to the results of analysis of the causes of midair near misses. Instructions are issued pertaining to what should be given greater attention in the future and what should be checked more thoroughly.

There are too many situations, however, which cannot be foreseen in advance; You cannot define procedures in response to everything that might happen in the course of one's duties. There also exists a limit to regulation of activity, after which rigid algorithmization begins to diminish the effectiveness of all work effort.

Alongside this it is important not to ignore another factor: purposefully to improve provision of information to air traffic control personnel and to provide for double or triple redundancy in information flow. This means not only improving technical means of control, visualization of the air traffic situation, and prediction of airspace conflict situations, but also improvement in organization of mutual coordination among civil and military air traffic control and command post personnel.

For example, radio communications procedures to be used between air traffic control personnel and aircrews are specified by the appropriate radio communications regulations. They state that received information shall mandatorily be repeated back in order to increase reliability of information transmission. In many cases a person is capable of performing a number of actions mechanically and without being consciously aware of them. This occurs particularly frequently in conditions of information overload and air traffic controller fatigue, as well as with diminished motivation. In this connection it becomes understandable why near misses occur not only at times of heavy traffic but also in clear weather, in low-traffic areas, during the day, in good visibility.

Speaking aloud (so-called verbalization of information) helps a person become aware of the actions he is performing and helps increase their reliability. Unfortunately such a procedure is not taught in exchange of verbal information between air traffic control ground services personnel. Is it then surprising that, upon being informed that flight level 4,800 meters is being closed, a controller closes 3,600 meters instead, and writes 13:25 instead of 13:30 for commencement of this airspace

restriction? We could continue the list of such mistakes, which are capable of causing collision-threatening situations. Today there is an urgent need to establish a radio communications procedure with maximum elimination of automatic, unconscious actions, especially pertaining to receiving information on flight operations conditions.

It is particularly important to provide air traffic control personnel with feedback on actual execution of instructions pertaining to closing an airway or placing restrictions on certain flight levels. The following problem also needs resolving. In order to cross an airway, a pilot is supposed to make a specific request and receive specific clearance. But there occur instances where a pilot is wrong in figuring his aircraft's position relative to the airway. What should be done? There is no ready formula.

Dangerous collision-threatening situations and ATC violations.... Attempts to link them statistically would probably be in vain. It is necessary constantly and continuously to analyze the psychophysiological reasons for faulty, untimely, and other than optimal actions by air traffic control personnel. Reliability of the human factor in air traffic control is a very important component for improving air safety.

COPYRIGHT: "Aviatsiya i kosmonavtika", 1989.

#### **Air-Mishap Culpability Factors Analyzed**

91441288g Moscow AVIATSIYA I KOSMONAVTIKA  
in Russian No 4, Apr 89 (signed to press  
14 Mar 89) pp 18-19

[Article, published under the heading "Flying and Psychology," by Docent Col (Res) Ye. Kolomiyets, candidate of technical sciences: "Is the Pilot at Fault?"]

[Text] An air mishap occurred. What a sound of finality these words have: "Made a mistake," "acted incorrectly," "lost control," "displayed indiscipline," "pilot is to blame." Both the pilot and his superiors are punished. Measures are taken "to improve things".... Air mishaps caused by similar or identical pilot errors happen again, however. They are called "typical errors."

But if errors are "typical," they consequently lie in waiting not only for a pilot who has committed an offense and has been punished but also every other pilot as well. In such a case can one blame the pilot for all the difficulties a person experiences during flight and which lead to errors?

Studies have established that the human operator, bearer of specific personal, professional and physical characteristics, and equipment, possessing inherent features of work station, information field, stability, and controllability, are interlinked sources of mistakes in operating and controlling technical systems. Adverse individual features which increase the probability of faulty actions include feeling sick, inadequate level of training, weak professional abilities, and indiscipline. Counterpart features applying to the aircraft include inconvenient,

unsystematic placement of control, insufficiency, uncertainty, or incorrectness of displayed information, poor capability of information sources to attract the pilot's attention, discrepancy between control mechanisms and patterns and natural human reactions, poor, inefficient distribution of functions between pilot and automatic system, etc. The worse the human operator's individual characteristics and the more strongly-marked the equipment "ailments," the higher the probability of mistakes by the human operator in operating or controlling any equipment.

In machine control the term "human factor" is applied to designate a group of causes of faulty actions due to discrepancy between the required and available capabilities of a human operator as a biological system. The term "personal factor" is applied to that group of causes of human errors connected with the personal, individual shortcomings of a given human operator.

If a pilot error is caused by a personal factor, it is correct to consider personal responsibility by the pilot himself and possibly his superiors as well. If an error was determined by the human factor, in this case it is correct to consider responsibility not on the part of the human operator himself but rather those persons who placed him (deliberately or through incompetence) into clearly adverse conditions which do not guarantee mistake-free actions.

The methodology of study and analysis of pilot activities in various flight conditions has been examined in publications time and again. In spite of this fact, however, there still remains a tendency to view all pilot erroneous actions as a result of his personal deficiencies and, consequently, to blame him for them. Such a principle is temptingly simple and convenient for a voluntaristic, administrative-dictate work style, and for that reason it persists.

It is simple, to be sure, but it is also unethical. No wonder one can frequently hear the following reflex-type comment: "The switchman is always to blame." We are dealing here not only with ethical distortions. It is much more serious: the actual causes of air mishaps remain undiscovered. We should recall, however, that theory is "dry." Let us turn to actual examples.

...In the course of checking operational reliability of a heavy aircraft pitch damper system in flight, the testing operator, having warned the pilot, switched on the pitch control rod malfunction simulator. The pilot, applying smooth but vigorous force to the control yoke, repeatedly and in various flight configurations, countered disturbances in aircraft pitch caused by the introduced malfunction. As they were approaching the field after completing the procedures, an actual malfunction of this type suddenly occurred. The pilot put aircraft into pitch oscillation. He failed to place and hold the control yoke in neutral position, as proper procedures required in this situation.

Is he at fault for the fact that he pitched the aircraft nose up and down rather than holding the yoke in neutral position? The flight data recorder tapes indicated that the intensity of the control disturbance (rate of increase in pitch angle and load factor) during the actual malfunction did not exceed that of the simulation. But the rate of yoke deflection when countering the first, unexpected pitch-up exceeded that of yoke movement when countering anticipated simulated malfunction by severalfold, while there was several times less delay in pilot reaction. Thus he reflex-reacted to a sudden pitch disturbance of the same intensity: with minimal delay, with a sharp yoke deflection at maximum rate, in the correct direction. But with a great deal too much yoke deflection! He reacted with greater delay to the anticipated pitch disturbance, suppressing his reflex, responding at a moderate rate and precisely applying the required yoke deflection.

The pilot's first reaction to the unexpected pitch disturbance was determined by the human factor, not the personal factor. His response did not correspond to the requisite control movement to counter the pitch disturbance. His actions were wrong from this standpoint. But not due to the pilot's fault. He simply was unable to act otherwise.

Why did the yoke not remain in neutral position during the pitch oscillation? It was ascertained that the control system had not been designed for maximum rates of yoke deflection by pilot reflex action and was unable to respond as a consequence of booster valve "jamming" into the feedback nut and elastic deformation of the control linkage with subsequent self-slacking of the RAU [expansion unknown] mechanism. When the control yoke stopped, the valve continued movement due to the flexing control linkage and release of the RAU mechanism. This caused stabilizer overdeflection and a change in angular accelerations and load factor with motionless control yoke which the pilot was not expecting.

The pilot again reflex-reacted to this new unexpected occurrence. His reflex was like the reflex of instantly raising one's arm, for example, to maintain one's balance when falling. As a result of this reflex reaction he increased the aircraft's degree of pitch excursion instead of performing the recommended procedure (holding the yoke in neutral position).

The pilot could have killed the pitch oscillation by holding the control surfaces in trimmed position. The pilot needed time, however, to recognize the phenomenon, to suppress the reflexes caused by and maintained by the aircraft's aberrant behavior, to suppress the dominant centers of stimulus which require immediate reaction, to bring to mind the operating manual recommendations and, finally, to make the correct decision: to stop applying interfering control pressure. Usually this can be accomplished only after one and a half to two full oscillations, of course if the aircraft does not stall out or break up prior to this point. We now see that the pilot's error—"failure to follow recommended procedures as prescribed in the manual"—is also due to the human factor, not the personal factor, and cannot be blamed on the pilot.

In order to prevent the possibility of an aircraft going into oscillation when sudden disturbances occur, it is necessary either to ensure that the control system will operate when reflex deflections of the control yoke at maximum rate occur, or to prevent such a rapid rate of control yoke deflection by technical means, which was in fact done by installing a hydraulic yoke displacement rate limiter.

...During a check ride in an L-29 trainer, the instructor was unable to control the aircraft when attempting recovery from an intentional spin. The aircraft transitioned into rotation opposite from the original spin rotation, from which the instructor could not recover. The instructor and student pilot bailed out after three turns.

The subsequent investigation report contained the following conclusion: the cause of the accident was pilot error during recovery from a left-hand spin. The report failed to state precisely what pilot error had been committed. The data recorder tapes had not been preserved, and therefore the finding of instructor pilot error was reached on the basis of the fact that no malfunctions in the control system had been found and that an L-29 always recovers from a spin when the pilot performs correct procedures. The error established by this sequence of logic was placed with the pilot.

Is such a conclusion valid? One should first determine precisely what errors could lead to the above-described incident and determine their possible causes. This was not done in the official investigation of the incident. The pilot claimed that he precisely followed the procedures prescribed by the operating manual, exactly as in 240 previous successful spin recoveries.

Let us examine one of the most probable scenarios. We know that when the pilot performs correct procedures for recovery from a left-hand normal spin after the first turn, the L-29 may sometimes rotate back into a right-hand spin. We should note that the word "sometimes" emphasizes the random nature of this event and its dependence on a number of unpredictable factors: air turbulence, state and condition of the fuselage nose section surface, and deviations in rate, magnitude, discreteness and phase in control pressures from the standard procedure recommended by the manual.

If we exclude the first two factors, the following erroneous procedures scenario would be possible.

**First.** Deviations from the recommended standard procedure did not exceed limits dictated by human capabilities pertaining to precision of execution, since the standard recovery procedure had been practiced correctly and had always proved effective in previous spins. There is a possibility, however, that on this occasion all deviations happened to combine adversely. This is a rare but possible event. This also could have led to rotation back into a right-hand spin. Actions of this kind, however, are caused by the human factor, and there is no pilot culpability here.

**Second.** Deviations went beyond the limits of probable errors. In this case we should assume change in the prior-developed standard procedure and look for the cause of this phenomenon. We shall attempt to do this.

The aircraft operating manual states: "If the aircraft has rotated back into a spin in the opposite direction, establish neutral ailerons and perform the spin recovery procedure described above"—that is, the same as when recovering from an intentional normal spin. We read further: "If the aircraft fails to recover, return controls to neutral and, after half a turn, repeat spin recovery procedure."

What did the pilot do? Here is his testimony. "I brought the controls to neutral.... The aircraft completed a half turn, after which I moved the controls and initiated recovery.... But the aircraft continued its right-hand rotation. I made three recovery attempts, repeating the procedure every half turn."

Thus according to the pilot he manipulated the controls in the spin recovery procedure for half a turn, and then again returned controls to neutral. If for any reason aircraft delay in spin recovery exceeded half a turn, the pilot by his actions could have prevented the aircraft from spin recovery, prematurely (after half a turn) returning the controls to neutral.

The manual does not state how much time one should hold the controls in the spin recovery position before deciding that the aircraft has failed to recover and returning the controls to "spin entry." Nor is there any information on aircraft delay in spin recovery following more than two turns. Therefore it is quite natural that the pilot subconsciously transferred the statement in the manual to the effect that the controls must be held in the "spin entry" position for half a turn prior to a repeated spin recovery attempt over to the time for which one should hold the controls in the "spin recovery" position, since this was the only information on cyclic recurrence of actions in the pilot's memory.

Thus if for some reason delay in spin recovery increased by more than half a turn, the pilot's actions were incorrect, but once again caused by the human factor. In this as well there is no personal pilot culpability.

While we could explain the aircraft's transition from a left-hand to a right-hand spin as a random adverse combination of maximal deviations in the pilot's actions, but within normal limits, it would be incorrect to ascribe increase in delay in spin recovery to chance, since the event repeated three times.

We must therefore assume that the pilot deviated from his previously-practiced recovery procedure. The most probable error was failure to push the control stick far enough for spin recovery since, as we know, this leads to transition from a left-hand into a right-hand spin and at the same time to increased delay in spin recovery. This

situation can occur if, for example, instructors recommend that pilots, for more precise control stick placement for spin recovery into the position prescribed by the manual ("somewhat forward"), determine correct placement not by position but rather by lack of pressure on the stick.

The fact is that when the stick is in neutral position "for recovery," pressure during spin recovery runs approximately 20 kg. The elevator will then be neutral, and delay will not exceed 0.3-0.5 turn. But when there is no pressure on the stick in "recovery" position, the elevator will be deflected (depending on initial trim) 4-7 degrees nose high. Delay could be as much as one and a half turns.

In this case the pilot's error will be due to the fact that the operating manual lacks any information on maximum delay in spin recovery after which the pilot should again move the controls to "spin entry," as well as due to the unwarranted recommendation on manner of placing the control stick "somewhat forward."

...Five minutes before arriving at an unfamiliar destination airfield, where a welcoming ceremony awaited the aircraft (opening of a new air route), the pilot was cleared for a straight-in approach. Thirty seconds after this the navigator shouted: "Captain, we are practically right above the runway!" the pilot, seeing the runway, descended steeply and landed on ...a short concrete strip used by crop dusters. He touched down with excessive airspeed. During rollout the landing gear collapsed, and the aircraft was damaged. The passengers and crew were miraculously unhurt.

How could it happen that none of the crew prevented this mistake? Psychologists who investigated the incident produced some answers. The pilot, requesting and receiving clearance for a straight-in approach, set himself up mentally for this type of approach and focused his efforts on the execution, since the people on the ground were waiting particularly anxiously for the aircraft to land. The navigator's shout: "We are practically right above the runway!" activated that portion of the pilot's cerebral cortex focused on the straight-in approach. Looking groundward, the pilot saw a concrete runway directly ahead. Since he saw what he was expecting to see (he had no knowledge of the existence of the crop duster strip), he had no reason to doubt that this was his destination. This was sufficient to trigger actions which had been planned in advance and which he was anticipating at any minute.

Since the aircraft was about to overshoot the field, the pilot's attention concentrated to an even greater extent on accomplishing the straight-in approach. A dominant state arose which hindered perception of information not directly required for actions connected with putting the aircraft down on a runway that was "getting away." Visual images which indicated that the aircraft was landing at the wrong airport were simply not perceived by the pilot. In a state of dominant stimulus, the pilot



acted as a simple aircraft-landing automaton. Such peculiar stubbornness was caused by the human factor.

The precondition for the occurrence of such conditions, however, was also affected by the personal factor: the pilot failed to carry out the planned landing pattern procedure (after circling over the unfamiliar field).

Then why did the navigator say nothing? It was determined that the navigator, upon suddenly seeing the concrete runway, thought that his calculations had been wrong and frantically shouted, warning the pilot: "We are practically right above the runway!" As they were descending he realized that he had been mistaken. But he was "embarrassed to admit" his mistake. His feeling of embarrassment and fear of subsequent jokes at his expense produced stronger motivation to remain silent than his sense of duty and self-preservation.

And what about the copilot? The copilot had been unfairly bypassed in promotion. He remained silent in order to make the pilot look bad. He admitted: "I saw right off that this was the wrong field. But I wanted everybody to see that the left-seater was a poor pilot." Here too feelings of injured pride proved stronger than self-preservation and sense of duty. The personal factor was operating in these instances.

The cited examples attest to the fact that pilot errors due to the human factor and personal factor can arise at all levels of the macrostructure of activity. At the activity level—as a consequence of distortion of motivation for activity. At the action level—as a consequence of disparity between a person's subjective goal and objectively-stated tasks, due to distortion of the conceptual model of flight or impoverishment of operative images. At the operation level—as a consequence of a discrepancy between the conditions of performance of operations and the stated tasks.

One must therefore conclude that specialist-psychologists should be enlisted to investigate complicated flight circumstances. The common sense of non-specialists may fail to notice and comprehend a great deal and may distort many factors, reaching an incorrect answer to that age-old question: just who is to blame?

COPYRIGHT: "Aviatsiya i kosmonavtika", 1989.

### **Cosmonaut Recovery Capsule Search and Recovery Operation**

91441288h Moscow AVIATSIYA I KOSMONAVTIKA  
in Russian No 4, Apr 89 (signed to press  
14 Mar 89) pp 21-23

[Article, published under the heading "People of Duty," by AVIATSIYA I KOSMONAVTIKA special correspondent S. Skrynnikov: "Search and Rescue...."]

[Text] We were heading out on a cosmonaut recovery mission. An international crew consisting of V. Titov, M. Manarov, and French citizen Jean-Loup Chretien should soon be landing in the designated recovery area.

The helicopter was literally fighting its way through a blizzard. Visibility was virtually zero.

The helicopter crew and the search and rescue service specialists were calm, however: they had experienced such conditions during training drills and during the real thing. They had full confidence in the skill of the pilot, Maj A. Seleverstov: they knew that this time as well he would put the helicopter down alongside the recovery capsule with timeliness and accuracy. But was this flight not dangerous for them? Search and rescue people do not think about themselves....

A special kind of person chooses to work in search and rescue—a person of exceptional valor and courage, totally dedicated to the job. If a selfish individual happens to get in by chance, he will not last long. In emergency situations it is immediately apparent what a person is made of.

The search and rescue people themselves consider their profession to be one of the world's oldest. That is a fact because, as we read in the Dal dictionary, "spasitel [rescuer, savior]—one who rescues or saves, or has rescued or saved somebody"; "spasitelnaya lodka [lifeboat]—a boat specifically fitted and equipped for saving lives during a shipwreck." The search and rescue profession apparently came into aviation via the navy, and became one of the most needed professions.

There have been many bright pages in the history of the air search and rescue service. Back at the dawn of aviation many pilots' lives were saved. In the first long overland flight from Saint Petersburg to Moscow in 1911, only one of the pilots who started, by the name of Vasilyev, made it all the way. The remainder "dropped out of the race," and they had to be searched for. The first experience in extracting aircrews in combat conditions was acquired during World War I. Soviet aviators courageously went to the rescue of comrades in the battles of the Civil War.

The search and rescue people are proud of the fact that fellow search and rescue personnel, who went to the rescue of the crew of the "Chelyuskin": A. Lyapidevskiy, S. Levanevskiy, V. Molokov, N. Kamanin, M. Slepnev, M. Vodopyanov, and I. Doronin—were the first to be named Hero of the Soviet Union. Famed Soviet air ace S. Gritsevets was awarded a second Gold Star for rescuing from enemy-held territory regimental commander V. Zabaluyev, who had been shot down in air-to-air combat over the Khalkhin-Gol River. Many Soviet pilots performed such deeds during the Great Patriotic War. Sr Lt A. Demekhin, for example, landing in enemy dispositions, risking his own life, took aboard the crews of two other aircraft which had been shot up and disabled by the fascists. On many occasions international-aviators rescued comrades in Afghanistan. The exploit of Hero of the Soviet Union Maj V. Shcherbakov, who extracted the crew of a crippled helicopter literally out from under the noses of the mujahideen, will go down permanently in history.



Today the National Air Search and Rescue Service is a centralized organization charged with search and rescue of passengers and crews of aircraft, seagoing vessels, and spacecraft, including foreign, on Soviet territory, as well as victims of natural disasters.

When landslides, floods, fires, avalanches, and mudflows occur, aviators immediately come to people's aid. This was the case, for example, following the earthquake in Armenia in December 1988. Aviators flew approximately 6,000 injured just out of Leninakan and Spitak.

...We were approaching the projected touchdown point. Other squadron helicopters were flying somewhere nearby, invisible in the snowstorm.

I knew that at this moment service chief Lt Gen Avn D. Demyanenko, officers Yu. Agapov, V. Bezmalenko, V. Bruss, Z. Gabdullin, G. Golub, V. Malyshev, B. Pokhomenko, G. Solokhin, K. Terentyev, V. Fesenko, V. Khokhlov, V. Chumbayev, and others were bent over maps at the USSR National Air Search and Rescue Service Command Center, analyzing reports from the cosmonaut landing site.

Dmitriy Ivanovich Demyanenko became enamored with aviation as a child and donned the blue shoulder boards at the age of 15, enrolling at the Rostov Air Force Special School. In 1946 he became a cadet at the Bataysk Military Aviation School for Pilots. During his long and interesting career in aviation he has moved up the echelons of flight and staff duty and has trained highly-skilled pilots. In particular, Hero of the Soviet Union A. Rutskoy became a skilled pilot under his tutelage. It seems that Dmitriy Ivanovich knows everything and can do everything. This is just the kind of specialist that is recruited into the Search and Rescue Service. There should be no mistakes in selecting personnel. Sometimes too high a price—human lives—is paid for lack of efficiency and a lack of professionalism.

Search and rescue service specialist personnel have amassed a great deal of experience working in high-mountain and Arctic regions, while many did hard duty in Afghanistan and hold combat decorations. They include many masters of sport in sport parachute jumping, who have made thousands of jumps in difficult conditions, including into forest and onto water. For this reason every word in the report from the search and recovery teams for them is filled with profound content. It is as if they themselves are present where the events are taking place and at any moment could suggest the best course of action.

On this occasion, due to an emergency situation occurring aboard the spacecraft, it has been necessary immediately to change the landing time and recovery area and correspondingly to redirect personnel and equipment.

Of course they had provided for, checked out and thoroughly rehearsed just for such a turn of events. Command Center personnel worked with precision: they

were in communication with experts in ballistic trajectory computations, with mission control, and with the weather forecasters.... Carrying out the new instructions, fixed-wing and rotary-wing aircraft were already flying into the new recovery area, and ground search and recovery vehicles were plowing their way through as well.

...Having completed the familiar procedure of checking their parachutes and gear, Search and Rescue Service senior search and rescue instructors Sr WOs A. Zatsepin and V. Kirichenko were calmly waiting for the command to jump. Their job was to provide initial assistance to the cosmonauts if the helicopters and ground search and recovery vehicles were unable to reach the recovery capsule by touchdown. Both were experts at their job, with more than 15 years service in the detachment, and each had made more than 500 jumps. They could jump in any weather, day or night, into any landing site. I had a chance to see what accurate jumpers they were when I was present during preparations for the cosmonaut recovery operation. I asked them to land as close to me as they could so that I could get the picture I wanted. We subsequently measured: 5 centimeters from the center of the bull's-eye!

I recalled Kirichenko's description of one of their training drills. They set up camp in the forest for 72 hours after landing, in winter, eating only what they had in their survival kit, plus what they could forage. But in winter the gifts of the forest are gifts only in the store; out in the woods one must go out and get them. One must know what to dig up, where and how, and how to prepare it. Kirichenko, Zatsepin and their comrades are experts at this. Once there was an airplane crash. They were able to determine the crash site. Parachutists were dropped into the site. Finding the crash site was one thing, but rescuing the survivors was another thing altogether. They could have easily frozen to death together with the downed aircrew, but the skill and experience of Kirichenko and Zatsepin saved the day. They followed the first two parachutists in, built an igloo shelter, and got the crash survivors warm and fed. Everybody did just fine.

In my opinion many of the skills learned by the Search and Rescue Service should be made available to the public. Analysis of the aftermath of crashes and natural disasters indicates that trained individuals have a much greater chance of surviving and keeping well. And Search and Rescue Service specialist personnel are willing to share their knowledge. Senior Warrant Officers Zatsepin and Kirichenko can offer an entire "book of practical experience," containing dozens if not hundreds of recipes they have devised for dishes made of wild onion, roots, branches, and buds. This book also describes ways to make a fire, shelter, and create a positive attitude out of "nothing".... In short, this is not a book of recipes, but a book of life! It is interesting and very useful.

The search and rescue people also have their problems.

"Of course we do!" smiled Zatsepin, and then added in a serious vein: "We can't do it all. Industry must also

help us and the people who get into trouble. We need a good, specialized parachute, and we need lightweight tents. We also need convenient, reliable gear. Frequently we must make it ourselves or do our own modification of existing gear."

Detachment search and rescue service chief Maj A. Golenkov, search and Rescue team leader Capt A. Skorokhod, and senior search and rescue instructor WO V. Rusnov were also ready to jump.

Powerful search and recovery vehicles equipped with communications transceiver and navigation gear were proceeding along the ground toward the recovery site. Driver-technician 1st Class WO N. Smetanin was aboard one of these vehicles. In his 12 years of service he has logged more than 100,000 kilometers on the steppe. "I am on my third revolution of the earth," jokes Nikolay Aleksandrovich.

In 1983, during a night recovery, he was the first to arrive at the landing site of the recovery capsule containing cosmonauts V. Lyakhov and A. Aleksandrov, helping them exit from the capsule and driving them to a nearby airfield. He will never forget that experience.

...Finally, in a break between snow squalls, we caught sight of the just-landed recovery capsule and a helicopter on the ground alongside it.

"Karasev has gotten there first again!" Seleverstov exclaimed with delight. "Good man, that Nikolay Vitaleyevich! Quite a daring guy. He can do everything. He always gets there first. In short—a squadron commander! That's okay, we also arrived in time."

Lt Col Med Serv N. Vorobyev loped over to the recovery capsule and peered into the view port. The cosmonauts were smiling and pointing thumbs up: "A-OK!" Personnel from a search and recovery vehicle which had driven up opened the exit hatch with a wrench.

They pulled out the mission commander first. V. Titov said: "I've been away for a whole year!"

Next came Chretien.

"Greetings!" he exclaimed and smiled at the recovery people.

Manarov was last to climb out of the capsule; he sat on the edge of the exit hatch and looked around at the landing site. It was immediately apparent that he was in good health. It was hard to believe that he had been away from the earth an entire year. It seemed as if he would jump down onto the ground and say: "Well, why are you standing there with a stretcher?"

But procedure must be followed. The cosmonauts were carried into a tent. Their blood pressure was taken, and other objective indicators were measured. Every three minutes the radio operator transmitted data on the cosmonauts' subjective state of physical well-being. All readings were nominal.

After a short rest and a "picture for posterity" taken by the tent, the cosmonauts climbed unassisted aboard the helicopters, which flew them to Dzhezkazgan; from there they flew by fixed-wing aircraft to Moscow, to Zvezdnyy Gorodok.

"Well, time for a little rest?" I asked Col V. Zinovyev, search and recovery operations group chief. "After all, it is not every day or even every month that cosmonauts land."

It's a bit early to knock off work," replied Valentin Yevgenyevich, absorbed in his thoughts. "A bit early. The search and rescue service doesn't generally have time to take it easy."

COPYRIGHT: "Aviatsiya i kosmonavtika", 1989.

### Responding To An In-Flight Emergency

91441288i Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 4, Apr 89 (signed to press 14 Mar 89) pp 24-25

[Annotated diagram: "Emergency Situation"]

[Text]

COPYRIGHT: "Aviatsiya i kosmonavtika", 1989.

### Soviet Unmanned Space Shuttle Flight Detailed

91441288j Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 4, Apr 89 (signed to press 14 Mar 89) pp 26-28

[Article, published under the heading "Space Flight Support," by Doctor of Technical Sciences V. Kravets, mission director, Buran space shuttle orbital flight; O. Babkov, deputy chief designer: "First Flight"]

[Text] Development of the space shuttle, followed by preparation of Buran for the mission, commenced against the background of further development of space station projects. This naturally created additional organizational and technical difficulties.

Out of considerations of crew safety, the first test flight of our space shuttle was planned from the outset as an unmanned mission, which is traditional for the Soviet space program. This required that we fully automate all dynamic operations, right down to runway taxiing.

This mission was in the making for more than 10 years. The tension on launch day was heightened by the previous scrubbing of the 29 October launch.

On 15 November the entire launch countdown proceeded without a hitch. The Energiya launch vehicle carrying the shuttle Buran lifted off the launch pad precisely at 0600 Moscow time and almost immediately disappeared into the low cloud cover.

The eight minutes of the boost into orbit seemed to drag on amazingly long. At 06 hours 08 minutes 03 seconds Buran began its first solo flight....

One feature of the ballistic configuration of the Energiya-Buran complex is that the launch vehicle shuts down at an altitude of approximately 150 km, and the Buran must be final-boostered into orbit with its own propulsion system. For this reason in the first 40 minutes two maneuvers are performed to place the craft into an operational orbit with the following parameters: inclination 51.6 degrees, altitude 260 km. The parameters of these maneuvers (magnitude, direction and engine burn) are automatically computed by onboard computers according to the preprogrammed mission configuration and the actual parameters of motion at the moment of launch vehicle separation.

The first maneuver is executed within land tracking station line-of-sight, while the second is executed over the Pacific. Transmission of telemetry on the second maneuver proceeds from the Buran to a tracking facility ship in the Pacific to a geosynchronous communications satellite to the Orbita communications relay station at Petropavlovsk-Kamchatskiy to a communications relay satellite in a highly elliptical orbit to a communications relay site near Moscow to Mission Control, a total distance of more than 120,000 kilometers!

When not involved in maneuvers, Buran is positioned with its left wing facing earth to maintain proper temperature conditions aboard. The correctness of this shuttle attitude is confirmed by telemetry and by a view provided by an onboard TV camera positioned on the shuttle's longitudinal axis next to the windshield. The radio command link works perfectly: all commands to control Buran's telemetry and TV systems transmitted from Mission Control are executed.

One of the final operations commences: loading instructions into the onboard computers for the reentry phase and for transferring fuel from the nose to the aft tanks to establish landing trim. At this point there was an interruption in telemetry transmission.

Running somewhat ahead, we should note that there were some problems with certain onboard systems on Buran's first test flight. But not one of these problems was of a serious nature and had no effect on accomplishing overall mission objectives.

One and a half hours into the flight, the onboard computers were already calculating and communicating to Mission Control the parameters of the deorbit maneuver. At 0820 the engine ignited, slowed the shuttle the proper amount, and the ship proceeded to drop out of orbit. 30 minutes later the shuttle began to enter the atmosphere, and at 0853, at an altitude of 90 km, communications were interrupted by reentry heating. Buran spent more than three times as long in the plasma from reentry heating than is the case with Soyuz craft, a total of 16-19 minutes.

Finally, at 0911, when the shuttle was at an altitude of 50 km, reports came in: "Receiving telemetry!", "Landing site radar contact with shuttle!", "All shuttle systems nominal!" At this moment Buran was about 550 km from the runway, and its speed, although reduced, was still 10 times the speed of sound.

The shuttle was slightly more than 10 minutes from touchdown.... The craft was decelerating rapidly from atmospheric friction. Buran was proceeding precisely along the predicted flight path; on the monitors at Mission Control the blip indicating the shuttle was moving toward the landing site runway practically in the middle of the approach corridor. When Buran reached an altitude of about 7,000 meters, a MiG-25 chase plane rendezvoused with the shuttle to escort it in, and we were able to see the shuttle on the TV monitor. It appeared to be intact and undamaged.

The final landing approach maneuver commenced. At an altitude of 4,000 meters the shuttle established its final approach glidepath. TV cameras at the landing site began transmitting images to Mission Control. One minute later the shuttle extended its landing gear.... Touchdown occurred at 09 hours 24 minutes 42 seconds. An exceptionally pretty, precise, elegant landing by an 8-ton colossus. It was simply hard to believe that this had been an unmanned flight.

The first unmanned flight of the Buran shuttle was over; the world's first pilotless landing of a space shuttle had taken place.

Pandemonium broke out at Mission Control! Grown adults, who had been in a serious and even somber mood during the final days of prelaunch preparations—engineers, candidates and doctors of sciences—jumped up from the consoles, clapping their hands, shouting in exultation, and embracing. This was perhaps a unique scene of sincere and universal rejoicing in the last 20 years of space flight control operations.

But it was necessary to restrain one's emotions: for 10 minutes after the shuttle rolled to a complete stop on the runway, Mission Control monitored the process of onboard systems shutdown. At the request of the post-mission servicing team, we sent a final command to the shuttle from Mission Control via communications satellite. Power was removed from Buran's electrical systems. That was it! The first test flight program was completed.

The entirety of amassed experience and know-how in development of unmanned and manned spacecraft carrying computers on board was utilized in designing the Buran's control system. Practical experience in controlling the flight of orbital space stations and expendable spacecraft indicates that an ever increasing volume of tactical control tasks must be handed over to the onboard computers and spacecraft crew, leaving Mission Control and ground personnel tasks pertaining to strategic planning, control in unforeseen situations, processing and interpretation of scientific and economic experiments and research.

## ОСОБАЯ

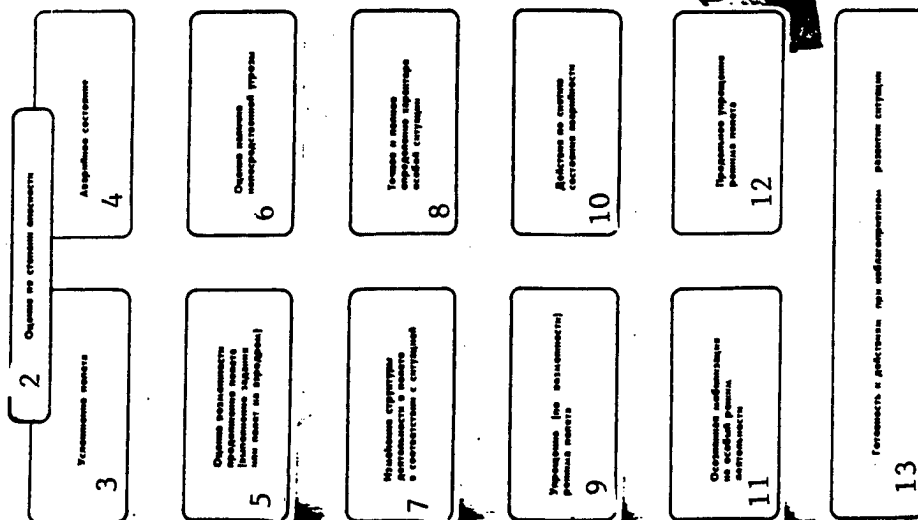
1

Общий порядок действий  
в особой ситуации  
не имеет значения и не  
используется при  
компьютерном моделировании

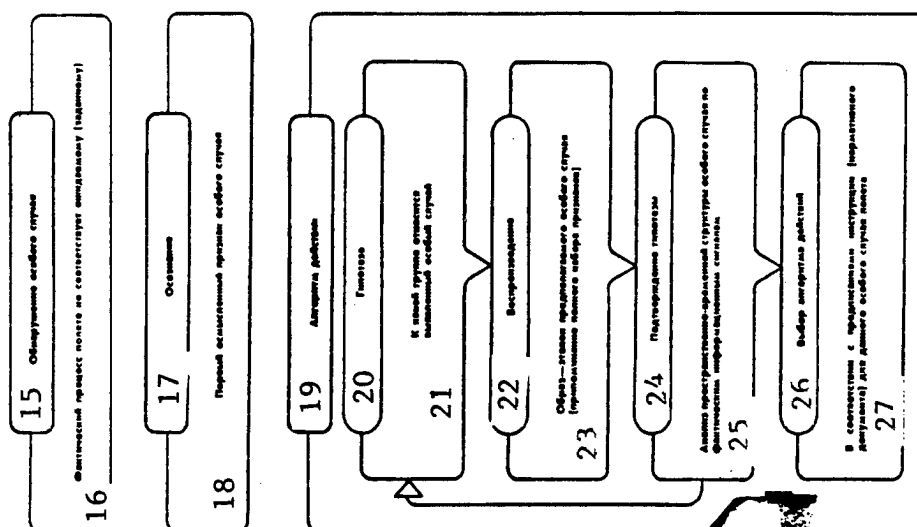
## СИТУАЦИЯ

14

Принят пакет  
информации  
действий в компьютерной  
особой ситуации



## Emergency Situation



---

Key:

1. General Sequence of actions in an in-flight emergency situation, regardless of specific content
  2. Assessment of degree of danger
  3. Complication of the flight
  4. Serious emergency
  5. Assessment of possibility of continuing flight (perform mission or return to field)
  6. Assessment of existence of immediate threat
  7. Change of structure of in-flight procedures in conformity with situation
  8. Accurate and full determination of nature of emergency
  9. Simplification (if possible) of flight configuration
  10. Actions to correct emergency situation
  11. Conscious mobilization to special procedures
  12. Maximum simplification of flight configuration
  13. Preparedness to act in case of adverse situation development
  14. Process of seeking a particular algorithm of actions in a specific emergency situation
  15. Detection of emergency situation
  16. Actual flight process does not conform to anticipated (intended)
  17. Awareness
  18. First realization of sign of emergency
  19. Algorithm of actions
  20. Hypothesis
  21. To what group does the given emergency apply
  22. Reproduction
  23. Standard image of presumed emergency (remembering a full set of symptoms)
  24. Confirmation of hypothesis
  25. Analysis of space-time structure of emergency according to actual informational signals
  26. Selection of algorithm of actions
  27. In conformity with procedures as prescribed in the manual (regulations) for the given in-flight emergency
- 

Proceeding from these considerations, functions pertaining to controlling motion, onboard systems operation and diagnostics, automatic control of backup onboard equipment units and modules, autonomous navigation and flight operations planning are assigned to the space shuttle's control system, based on a multiple-computer onboard system and special electronic equipment, and on a much larger scale than was the case with spacecraft and orbital space stations developed and operated in previous years.

The sequence of all required flight operations and their modifications for emergency situations required for automatic execution of the flight program was loaded into Buran's onboard computers while still on the ground during prelaunch preparations. If necessary the shuttle mission program can also be altered by radio command link from Mission Control.

Special functions are assigned to the launch vehicle and shuttle control systems as regards safety and safeguarding payload. In particular, in case of failure of one of the liquid-fuel engines of the Energiya launch vehicle, the control system performs optimal redistribution of the remaining launch vehicle and shuttle propulsion capabilities. There are three possible mission configurations: normal configuration with boost into a predetermined orbit, single-revolution (in case of launch vehicle failure in late stages of the boost segment), and Buran mission abort maneuver to an airfield near the launch complex (in case of launch vehicle failure at early stages of the boost phase).

All this required development of an unusually large volume of onboard software employing high-level problem-oriented languages both at the control system development stage and during ground and flight testing of the orbital vehicle. Special combined test benches were designed and built for final ground development of equipment and onboard software in standard mission configurations and in a foreseeable diversity of abnormal and emergency situations. The aggregate of problems pertaining to developing and testing onboard software became one of the central areas of work effort focus in designing and building the orbital vehicle.

The extensive capabilities of the control system involving onboard computers and the fairly flexible onboard computer software made it possible, even in the process of final ground testing, without changes in the equipment suite, to increase the operational reliability of individual Buran systems and the forthcoming mission as a whole.

During prelaunch preparation of the shuttle, particularly close coordination was established between the developers and testers of the control system and Buran's integrated propulsion unit, which is also one of the orbital vehicle's central and most complex systems. A quantitative description attests to the complexity of Buran's propulsion system: it includes 48 all-directional thrust-generating units. The two largest are designed for final orbital insertion, orbital maneuvering, and deorbit

braking, while 38 thrusters are used to control motion relative to the center of mass, and eight others for precision repositioning.

Another of the orbital vehicle's central systems is the communications and data link system, which has capability to exchange all types of flight information with Mission Control: command, telemetry, navigational, TV, and voice. This system also required considerable ground testing. Special attention was devoted to perfecting communications between Buran and Mission Control via a communications relay satellite in geosynchronous orbit. Routing of communications with the shuttle via communications relay satellite offers considerably greater capabilities than handling communications via land and shipborne tracking stations.

Development of the hardware and the procedure of automatic deorbiting and landing Buran on a conventional runway occupied a special place in mission preparations. The complexity of this problem is characterized by the fact that the descent path of a shuttle craft in the atmosphere is approximately twice that of one-shot spacecraft, while the required accuracy in landing at a conventional airfield is greater by three orders of magnitude. In addition, the approach and landing are executed under "engine-out" conditions, that is, the landing must be successfully accomplished on the first and only pass.

Flight along the descent path down to an altitude of 40 kilometers is handled autonomously by the shuttle's control system, while subsequent descent is handled with initial corrections by rangefinder system and subsequently by azimuth and elevation electronic beacon system. Shuttle craft attitude is controlled and adjusted down to an altitude of about 90 kilometers by thruster jets, between 90 and 20 kilometers with both thrusters and control surfaces, and below 20,000 meters by control surfaces alone. During the atmospheric phase of the descent, vehicle stability and controllability must span a range from hypersonic (above Mach 20) down to Buran's airspeed at touchdown—320-340 km/h.

All these specific features of space shuttle descent from orbit (precision landing approach and the need to accomplish landing on the first approach, flight and operation of flight controls across an unusually broad range of speeds, onboard control system adjustment from the ground) compelled the approach and landing control system developers to perform a large volume of experimental work at up to full scale, including aboard numerous flying laboratories.

Aerodynamic characteristics and controllability at hypersonic speeds were tested on geometrically similar models of Buran, which were boosted into suborbital trajectories by standard-model boosters, while control system operation at subsonic speeds was tested with the assistance of specially-equipped flying laboratories—modified Tu-154 and Tu-134 aircraft.

Ground telemetry, TV and voice communications receiving facilities deployed at the shuttle landing site were final-developed together with radar tracking and target designation equipment with the assistance of a specially-equipped MiG-25 aircraft used for escort and TV observation during Buran's descent. Radar flight-path information was processed on special mini-computers at the landing site, was displayed at the work stations of the regional approach and landing control team personnel, and was relayed in digital form to Mission Control for real-time display of the same image.

Radar flight tracking gear with information processing and display, rangefinding and beacon systems with onboard transponder equipment for adjusting the autonomous onboard control system were developed as an integrated electronic navigation and landing system.

The aggregate of all onboard and ground systems for shuttle flight at subsonic speeds and automatic landing was developed and tested on a shuttle analog craft fitted with additional engines to give it conventional runway takeoff capability. The flying laboratories and the shuttle craft analog made a total of approximately 150 automatic landings prior to the Buran flight. Future shuttle pilots flew the flying laboratories and the analog vehicle.

In spite of the extensive onboard automation of flight procedures, even during its brief maiden flight the orbital vehicle was connected to the ground via data and command links. Mission control exchanged all types of flight data with Buran: telemetry, navigational, command, TV; voice communications will be added on future manned missions.

The increased complexity and fast-paced sequence of in-flight procedures required greater automation of data processing and transmission at Mission Control. The volume of telemetry data transmitted from the shuttle (more than half of which comprised onboard computer data) had almost doubled in comparison with the Mir-Kvant-Soyuz orbital complex. Although exchange of command and program information with the shuttle was limited for the first flight, exchange was carried out at the machine-to-machine level: between Mission Control and Buran computers—in contrast to previously-tested space vehicles with onboard computers. For the first time in Soviet practice, processing of trajectory information from the space shuttle was performed on a close to real-time basis.

All these specific features of data processing and transmission made it necessary substantially to modify Mission Control equipment, to expand the volume of ground software, and to increase automation of preparation of input data for development of ground software.

A special facility with a new main control room and support team rooms was built at Mission Control and equipped by the commencement of preparations for flight-testing Buran. The capabilities of Mission Control's data processing system were substantially

increased by the addition of a PS-2000 and VS-2 fourth-generation computers, an elaborate coordination system of computer terminals, and employment of PC hardware. Overall output capability of Mission Control's data processing system increased to 50 million operations per second. The aggregate of newly-developed flight control software totaled approximately 2 million instructions.

The ground control system, the brain center of which is Mission Control, included six land tracking stations during the first Buran flight (at Yevpatoriya, Moscow, Dzhusaly, Ulan-Ude, Ussuriysk, Petropavlovsk-Kamchatskiy), four shipborne tracking stations (two vessels each in the Pacific and Atlantic), plus a communications and data transmission system linking the tracking stations with Mission Control. This system in turn consisted of a net of ground and satellite wideband and voice communications links. Three geosynchronous communications relay satellites and a group of several satellites in highly elliptical orbits were enlisted in support of the Buran mission.

Amassed experience in operating permanent orbital space stations and one-shot spacecraft indicated the need for combined development and testing of onboard and ground flight control equipment. During preparations for and during the Buran mission this idea was embodied in their functional integration and testing within the framework of an automated flight control system.

Mission control personnel underwent extensive training and preparation at Mission Control for the first Buran launch. About 10 combined practice drills were held during the final phase of preparations, in the four months preceding launch, involving the participation of all activated Mission Control facilities, tracking stations, range and landing complexes. All mission procedures were repeatedly rehearsed during these practice drills, with simulation of possible abnormal or emergency situations.

One objective of the first shuttle flight was continuation of flight development of the Energiya shuttle launch vehicle, structural testing of Buran, and operational testing of all onboard systems. For this reason the first, unmanned flight of Buran was to be short—two revolutions or 206 minutes of flight.

Work on the Energiya-Buran space shuttle system and its successful first test contributed to mutual enrichment of aerospace hardware development programs with up-to-date experience and know-how and contributed to the development of all-weather automatic landing systems, to the development of a massive experimental and test-bench support base, improvement and utilization of computer hardware, and acquisition of experience in developing and debugging large amounts of real-time software. One important aspect of development of the space shuttle system was the gaining of invaluable experience in organizing development of an automated flight control system with complex cooperative effort by participating agencies.

All this comprises today's contribution by Energiya and Buran to the overall development and advancement of our science and technology.

COPYRIGHT: "Aviatsiya i kosmonavtika", 1989.

### Early "Flying Tank" Experiments Described

91441288k Moscow AVIATSIYA I KOSMONAVTIKA  
in Russian No 4, Apr 89 (signed to press  
14 Mar 89) p 29

[Article, published under the heading "Responding to Readers' Questions," by Lt Col (Ret) K. Gribovskiy: "Wings for a Tank"]

[Text] "We have heard that a tank-carrying assault glider has been developed in this country," writes D. Vlaskov, a cadet at the Chernigov Higher Military Aviation School for Pilots, on behalf of his comrades. "If that is true, could you please tell us something about the design of this unusual aircraft and its performance characteristics?"

\* \* \*

The idea of using aircraft to transport tanks first emerged at the beginning of the 1930's. An analysis of design projects indicates that designers were working in several directions.

The first notion envisaged using heavy assault gliders to airlift tanks. This idea was articulated by famed designer P. Grokhovskiy, who in 1932 built the world's first assault glider to airlift 16 assault troops. This idea was not fully executed, however, until World War II, when several types of heavy assault gliders capable of airlifting light tanks and tankettes were developed in various countries. Difficulties arose with towing these gliders, since there were too few powerful glider-towing aircraft, which greatly limited their use. Therefore the majority were subsequently reworked into transport aircraft.

The second direction of development envisaged carrying tanks under the fuselage of powerful bomber aircraft. The first practical application of this principle was achieved in this country, once again by P. Grokhovskiy. Various bar-type sling mounts were developed for this purpose. In 1932 a device was designed and built for the transport and airdropping of a light tankette. It included a cargo parachute with a 30-meter diameter canopy, which was packed in a separate box.

The PG-12 universal device, designed to accept a variety of combat vehicles, including the T-37A tank, weighing 3,500 kg, externally under the TB-3 aircraft and landing them in an airborne assault delivery configuration, became operational in 1935. Crew members would remain in the vehicle during flight. Mounting shackles, which would be opened from inside the aircraft, provided quick release after landing. The first airlift of tanks using this system was demonstrated that same year at maneuvers in the Kiev Military District.

Designers also explored the idea of flying combat vehicles. The first proposal of this kind was made by U.S. tank designer Christie in 1932, who proposed to integrate one version of his high-speed tank with an airplane. His design called for attaching a biplane wing box to the top of the tank, with a cruciform empennage mounted on two vertically-placed booms. The overall length of the "flying tank" was 11 meters. The tank's powerplant was to consist of two 750 horsepower aircraft engines. One source stated that the tank's flying weight was to be in the order of 15,000 kg. Christie's "flying tank" design represented a complex technical problem at that time and was not implemented. That same year Soviet aircraft designer A. Rafaeilyants came forth with a similar proposal. Unfortunately it too lacked backing.

Famed Soviet aircraft designer O. Antonov devised a unique solution to this difficult problem. He proposed developing a hybrid tank-assault glider, which could transport a T-60 light tank. Work on the project commenced in December 1941. During development this unique glider was designated A-40 or LT ("flying tank"); subsequently it was called "tank wings" or designated by the abbreviation KT.

The glider consisted of a biplane wing box with a span of 18 meters and total wing area of 85.8 square meters, to which a tail assembly was secured on two booms.

The wings were mounted on the tank with special assemblies providing release after landing.

The two-man crew rode inside the tank, in regular tank seats; the pilot sat in the tank driver's position. A special optical instrument was devised to improve the pilot's view. The KT took off and landed on its own tracked chassis. Maximum designed gross weight of the glider-tank combination was 7,804 kg. Construction was completed at the end of April 1942, and soon it was transported by rail from Tyumen, where Antonov's design office was located at the time, to an airfield near Moscow.

Flight testing of the KT commenced following assembly and adjustment. Famed soaring expert S. Anokhin, who was subsequently named Hero of the Soviet Union, was designated the test pilot. Testing was performed with a lightened tank. Its turret and gun were removed, and it carried only 100 liters of fuel and a crew of one. The glider-tank grossed 6,720 kg in this configuration. The tank with airframe attached could travel under its own power across the ground at a speed of up to 15 km/h. Glider liftoff speed was 110-115 km/h.

The maiden flight of the KT took place on 2 September 1942. This was its first and only flight. The takeoff was uneventful, but soon the engines of the TB-3, which were operating on boost, began to overheat, since they were not powerful enough for a protracted tow. For this reason, after a short climb, Anokhin was forced to cut loose at the request of the towplane pilot and land at the adjacent airfield.

Thus ended the world's first flight by a winged tank. The testing was discontinued, since at the time a more powerful tow aircraft did not exist. Research was discontinued. One contributing element was probably the fact that production of the T-60 tank was discontinued at the end of 1942.

There was an attempt to build a similar winged tank, a small one, to be sure, in Japan at the end of the war, but it did not make it into the air. Subsequently the development of powerful military transport aircraft with large cargo spaces and effective air assault equipment made the idea of developing a winged tank obsolete.

COPYRIGHT: "Aviatsiya i kosmonavtika", 1989.

### Flight Surgeon Discusses Pilot Fitness, Medical Problems

914412881 Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 4, Apr 89 (signed to press 14 Mar 89) pp 30-31

[Article, published under the heading "Your Health," by Honored Physician RSFSR Maj Gen Med Serv S. Bugrov, chief, Air Force Aerospace Medical Service, candidate of medical sciences: "Extending One's Flying Career"]

[Text] Health and long life. These concepts have concerned man since ancient times. Man has always linked his dreams, hopes, and aspirations to these concepts. In the preamble to the Charter of the World Health Organization health is defined as a state of complete physical, mental, and social well-being. Longevity is a sociobiological phenomenon characterized by living to an advanced age, which contemporary gerontologists place at about 90 years. Academician A. Bogomolets considered 150-160 years to be the natural age limit for human life. Of course all of us are interested not in longevity records but rather in average life expectancy. It is easier to attain this category than the other, which unites those who have lived to maximum age. In addition people are living longer on the average, resulting in a greater number of people living to an advanced age.

The Program of the Communist Party of the Soviet Union ratified at the 27th CPSU Congress states: "It is a matter of paramount importance to strengthen the health of Soviet citizens and to increase the length of their active life."

The flying profession has no counterpart. The pilot's job is one of the most complex human activities. We are naturally primarily interested in problems dealing with the health of aviators and the length of their flying career.

The combat aggressiveness of the military pilot depends first and foremost on the state of his system, his physical endurance and a high degree of work fitness throughout his entire service career. Today's pilot is a highly-skilled specialist, on whose training years of intensive labor and a considerable amount of money are expended. According to reports in the Western press, for example, it costs almost 4.5 million dollars to train an F-15 fighter pilot.



How can we ensure a long flying career, physical and emotional health to the military pilot? These questions constantly occupy the attention focus of command authorities and the Air Force Medical Service.

We should note that while the average life span and state of health of flight personnel differ little from counterpart figures for the civilian population, grounding of flight personnel for medical reasons at an age of between 35 and 40 is reason for concern and alarm.

On the basis of statistics and my own experience as a flight surgeon, I would name affections of the cardiovascular system and nervous system as well as gastrointestinal ailments as the primary factors resulting in medical grounding of flight personnel.

Of course doctors and other medical personnel do everything they can to return pilots to health. This is not solely the job of medical personnel, however, for prevention of the majority of chronic ailments such as high blood pressure and ischemia, as well as diseases of the nervous system and gastrointestinal tract, depends in large measure on the patient himself. In my opinion a significant role in this is played by insufficient attention by doctors toward health improvement and educational efforts. What pilot is aware, for example, of the fact that about half of the approximately 3 million deaths each year are caused by cardiovascular disease?

These diseases are alarmingly widespread, affecting more than 25 percent of the population. This is a result of the fact that the majority of our population do not regularly engage in physical exercise or sports, while almost one out of every three persons is overweight, and one out of every four persons smokes.

Roughly the same figures characterize the state of health-improvement efforts in the Air Force. It has been established, for example, that from 18.7 to 52 percent of flight personnel are overweight, while the figure is 70 percent for 1st class pilots.

And yet there is a genuine possibility of substantially improving these figures. One example of this is the fact that in the United States and a number of other countries the mortality rate from cardiovascular diseases has been reduced by 25 percent in the last 10 years. The primary contributing factors are disease prevention measures, in which not only health care institutions and government agencies but the general public as well have become involved. Many people have given up smoking, have begun watching their weight, have been following a diet based on doctors' recommendations, and have become involved in running and bicycling, that is, they have been using all the means which today form part of the scientifically-substantiated arsenal of individual preventive measures.

Education on so-called risk factors forms the basis of the prevention campaign. The most common risk factors among flight personnel, as we know, are the following: effect of adverse conditions in flight and marked neuro-emotional stress, smoking and consumption of alcohol, a

sedentary lifestyle, high blood pressure, high-calory diet and related excessive intake of fat, and excess weight.

Risk factors exert an unusually adverse effect on the health and physical fitness of flight personnel. The effect of high and protracted G loads, for example, and decrease in oxygen pressure can cause loss of consciousness and, as a consequence, threaten flight safety and the life of crew members. Protracted noise leads to loss of hearing, the development of neurotic states, and affections of the gastrointestinal tract. Incorrect and delayed utilization of protective means leads to injury and death of flight personnel.

We should point out that modern aircraft contain everything needed to protect the pilot against the effect of adverse factors. It is effective, however, only with intelligent utilization. Therefore solid, profound knowledge of the rules and procedures of utilizing protective means is a mandatory condition for preserving and maintaining the health and fitness of flight personnel.

Let us now discuss the most widespread risk factors. We shall begin with smoking. Approximately 70 million persons in the Soviet Union are affected by this harmful and dangerous habit, although it is a well known fact that using tobacco increases the probability of suffering a coronary by a factor of 6.5. The danger of occurrence of gastrointestinal and oncological affections also increases substantially. There is only one obvious conclusion: people should stop smoking. For all intents and purposes this is a matter of willpower. Even the most skilled medical specialists are powerless in the face of this insidious foe, for treatment in the form of special pills, admonition, and acupuncture play only a secondary role. There is only one effective method: to marshal one's will and to give up smoking once and for all.

Abuse of alcohol is particularly dangerous and unacceptable for flight personnel. This poison rapidly exhausts the nervous system and causes psychoemotional disruption.

Consumption of any amount of alcohol is absolutely incompatible with flying. Consumption of 0.5-1 liter of beer, which corresponds to a 0.3-0.5 percent blood alcohol level, can appreciably diminish certain psychophysiological functions and can worsen flying technique. The adverse effect of alcohol on a pilot's professional reliability and length of flying career lies in disruption of mental functions: clarity of thinking, attention, as well as lessening the system's resistance to extreme factors of flight—hypoxia and G forces, and to irritations of the vestibular mechanism. The most adverse reactions, sometimes unexpected and difficult to diagnose, can be caused by a combination of alcohol and medication.

We should say a few words about another feature of the professional activities of flight personnel—physical inactivity. Due to the nature of his job, a pilot is characterized by a lifestyle involving little physical exercise. With comparatively small energy expenditures and a high-calory diet, one can easily put on excess weight, which certainly does not help improve physical stamina or

foster a long flying career. An overweight condition and accumulation of fat lead to affections of the locomotor system and have an adverse effect on the structure and function of the heart muscle.

Regular specialized physical training classes, brisk walking (6 km/hr), running, rowing, swimming, or tennis do a good job of countering this adverse factor.

An increase in cholesterol in the blood promotes its deposition on the arterial walls. A doctor will suggest ways to combat this dangerous phenomenon in each specific instance. But the following recommendations can be given to flight personnel. One should limit one's total caloric intake. One should substantially reduce but not totally eliminate foods with high cholesterol content: fatty meat, eggs, butter, etc. It is beneficial to replace a portion of consumed fat with vegetable oil, which impedes the development of atherosclerosis. It is advisable to consume vitamin-rich fruits and vegetables, cottage cheese, and fruit juices. It is essential to limit salt intake. Regular physical exercise and sports activities lower the blood cholesterol level.

We shall now discuss high blood pressure. It can be successfully treated with modern medication. Adequate, full-value sleep, regular and sufficient rest, and proper diet are important in preventing high blood pressure.

Research studies indicate that the average human lifespan should be 120 years and that man himself is to blame for the fact that he lives only half this amount by leading an unhealthy way of life. But reserve potential exists, and considerable potential at that. Prevention of cardiovascular ailments, for example, could increase the average lifespan by 17.5 years, while victory over cancer could extend the average lifespan by 2.3 years. Giving up smoking also represents a reserve potential for lengthening one's life, for smoking is the cause of more than 95 percent of all cases of lung cancer, throat cancer, and cancer of the tongue, while mortality among smokers (between the ages of 45 and 54) is 80 percent higher than among nonsmokers.

These are the sad statistics. At the same time giving up this pernicious habit would mean 8.3 years of "extra" life. Removing 4 kg of excess weight lengthens one's life by one year on the average. One can decrease by a factor of three the probability of experiencing a coronary by sharply reducing consumption of animal fats by substituting fish, poultry, fruits, vegetables, and nuts.

One must bear in mind that a proper diet is directly related to health and even to life span. An improper diet—monotonous, with limited vitamin intake (especially vitamins E, C, and A, as well as B complex)—shortens a person's life by 6-10 years. If one is overweight it is advisable to reduce food intake, limiting consumption of fats to 30 percent of the total caloric content of one's diet.

We should note that insufficient intake of minerals, such as in regions where the drinking water is "soft," fosters

the development of coronaries. Deficiency of vitamins and minerals in one's diet can be compensated for in part by taking multivitamin tablets with minerals (Glyutamevit, Amevis).

As already noted, disturbance of fat metabolism is not only linked to an incorrect diet but also is affected by the level of an individual's motor activity. Regular physical exercise, 1 hour per day, slows the processes of aging and can add an average of 6-9 years to one's life and can extend one's active career by an equal amount.

A high level of nervous tension, connected with intensive mental activity as well as conflicts on the job and at home, has an extremely negative effect on one's health. One can therefore readily understand the importance of observing a proper work and rest regimen and learning to control one's conduct wisely. To be a self-possessed individual, to possess self-control, controlling one's emotions and feelings means being a potentially healthy individual.

It would be erroneous to reduce the problem of the state of health of flight personnel solely to the medical aspects of this problem. Social aspects are of equal importance: the level of prestige of one's profession, financial situation, housing and living conditions, availability of children's institutions and facilities, availability of opportunities to meet one's cultural and spiritual needs, and availability of medical care for one's family. Analysis of this aspect of the problem indicates that the directional thrust of one's career activities is determined in large measure by the above-enumerated factors, and consequently the principal reasons for becoming permanently grounded must be sought here.

Decrease in career directional thrust and lack of desire to continue military service can nullify doctors' efforts to maintain and improve the health of Air Force personnel. This why a contribution, and a substantial one at that, to the problem of maintaining the health of flight personnel and maintaining a high degree of physical stamina and moral-psychological stability in flight personnel should be made by persons responsible for the social aspects of the matter, particularly commanders and political workers. Only through a joint effort will we be able to extend the flying career of our highly-valuable flight personnel, keeping them on the line.

COPYRIGHT: "Aviatsiya i kosmonavtika", 1989.

**Fulcrum Pilots Train for Tolerance to High G Forces**  
91441288m Moscow AVIATSIYA I KOSMONAVTIKA in  
Russian No 4, Apr 89 (signed to press 14 Mar 89) pp 34-35

[Article, published under the heading "Flying and Psychology," by Military Pilot 1st Class Maj V. Parkhomenko: "Trysts With a 'Grey-Eyed Beauty'"]

[Text] Following a short takeoff roll, the pair of MiG-29s nimbly lifted off and disappeared into the clouds.

"It is probably warm above the overcast," commented the aircraft technician [crew chief], watching the departure of his "twin tail," as he fondly called this combat aircraft. "Yes.... It's going to be even hot for them today," another ground crewman chimed in.

Intelligence had determined that the "enemy" was about to attack an important target. The mission was to prevent the attack, to keep the enemy from reaching the target. My element leader had decided to use a roving fighter sweep.

It would be necessary to penetrate "hostile" air defense. What would be the best way to accomplish this? The fighters commenced a "cobra dance." Flying at maximum speed and vigorously maneuvering, the element leader described an intricate, complicated flight path in order to break through the net of anti-aircraft assets. It was tougher for me, the wingman! The element leader would naturally leave me with available performance reserve to maneuver, for it is always more difficult for the wingman who is following his leader's maneuver. The leader was pulling 7 G's. And me? I was pulling 8. I was economizing in effort. Strength and energy would be needed in air-to-air combat with "enemy" fighters or if we were to attack a "cruise missile." The first thing to appear would be ours.

In actual fact things were difficult. All I could see out ahead of me was the lead aircraft. To the right and left was a grey shroud [reference to narrowing of vision at high G forces], swaying in rhythm with my breathing. The muscles of my entire body were so tense that they seemed to vibrate like guitar strings. Each second seemed like an hour. The main thing at this point was to monitor what was currently the main system—my own, for the slightest mistake in performance of procedures to counter the effects of high G forces can lead to loss of consciousness, or to a threat missile getting a lock, which amounts to the same thing—"death" and failure to accomplish the mission.

But I was confident that the practiced skills and habits I had acquired in working at high G forces, developed on the centrifuge and on training flights, would not let me down. I performed all procedures with confidence. Everything came automatically now. All that was necessary was closely to monitor conditions with my sensory organs.

My mind was working with precision, monitoring all elements. The leader brought his wings level, and I followed suit. I immediately felt relief. I was returning to my normal 70 kilogram body weight. I had full control over my body and breathing. And my reward for these labors was the fact that I felt almost no fatigue.

We commenced our search for the "enemy." He would not give up easily; he knew how to fight. What was that? There he was: our adversary was already attacking. I shouted: "123, initiate evasive maneuver!" And the leader executed a complex evasive move. There was nothing but a white

shroud [reference to "gun barrel" vision] trailing his aircraft. High G's once again to the rescue, thwarting the "threat" missile's homing guidance.

Now it was my turn. "Don't count your chickens, 'bandit'!" I rolled out and dove at him from above. He had no intention of turning tail. "Let's see who is top dog." There they were, those skills and practiced habits gained by working at high G forces! My vision was perfectly clear, although it was apparent from the burble wraiths streaming off the "threat's" wings that he was at maximum effort. He was trying to get away. High speed, afterburning, crushing G forces, but we were familiar with all this. I had a brief thought of gratitude to those guys on the centrifuge. "Thanks, you people in the white coats!"

I had him. I squeezed the firing button. The gun camera recorded the kill. I spotted my element leader. He was positioned close by, providing cover. It was time to return to the field—the duty shift was ending. We had accomplished our mission.

After landing, my element leader and I stood on the ramp, looked at each other, and for some reason broke out laughing. After all, a pilot without a sense of humor is not a warrior but a kamikaze pilot.

We of course were laughing at our past weakness. Just that morning we had been glancing back through the training diary and recalled our first encounter with high G forces—our "grey-eyed honey."

...At that time, that is, several years back, there were three of us. We were the first pilots in our line unit who would be learning to fly and fight at high G forces.

After all, it is impossible to predict the course of battle. He who is better prepared for battle in all respects will emerge the victor. Our job is to defend, and defense is always more difficult than attack. For that reason one must do a better job of preparation.

And we commenced training. It is apparent how we changed our opinion of G forces from our own observations and those of the flight surgeon. We already considered ourselves to be experts at G forces, for we had seen a thing or two in our 15-20 years in aviation. And then the special training began. We learned that it was one thing to pull high G's briefly during flight and quite another thing altogether when you've got to pull 8 or 9 G's for a period of 10 seconds or more.

Here they were, our first impressions. For us this was past history, but it might be a future story for others.

A little bit about ourselves. We were from 30 to 37 years of age. We were more physically fit than many others our age. I, for example, could do 25 pullups, hold an L-hang for more than a minute, run 30 kilometers, and a good deal else. I had an athletic build. My friends were in equally good shape.

What kind of entries do our training diaries contain?

## First day. Taking 7 G's.

Spun up to five and a half G's. Not difficult. But a slight inclination or turn of the head, and a slight dizziness sets in. After 15 seconds at 7 G's one feels slight, barely noticeable nausea, heart pounding, faster breathing. A slightly excited state continued up to taps. One is a bit distracted. When crossing a street where there is no traffic signal, you have to concentrate your efforts to assess the situation. You wake up frequently during the night. Shallow sleep. The gluteus muscles ache slightly.

## Second day. Rest.

The next morning you don't feel like you have gotten any rest. One feels a slight passivity. You don't have the slightest desire to fly or pull G's. Appetite normal. Tiredness in the afternoon, toward dinner, poor appetite. Neck and gluteus muscles ache worse. It is still unpleasant to think about G forces, although objective indicators are excellent: blood pressure 115 over 65, pulse rate 58. This is how our day of rest went.

## Third day. Rest.

Deep sleep. Slight sluggishness in the morning. Felt better after calisthenics, but I still don't feel like going on the centrifuge. Muscles seem weak.

## Fourth day. Taking 9 G's.

Deep sleep. Following calisthenics I gained the confidence needed for going to it, although muscles still not really recovered. Slept 8 hours. Wanted to sleep more, but it was time to get up.

I was afraid of 9 G's. When I hit six and a half, I was not sure that I could make 9. Confidence regained after pulling 8. Legs were plenty strong, but my gut felt weak, particularly in the lower abdomen. I've got to practice. It's hard to breathe. I think there is room for improvement, because I had not learned to breathe correctly at all times. I caught myself making mistakes. Particularly when breathing out: I breathed out through my lips rather than through the narrowed glottis. You've got to breathe out in such a manner that the lower gut tightens.

You've got to pay attention when coming off 9 G's. You want to relax too soon, but that could cause loss of consciousness.

After coming off 9 G's I felt hot and thirsty. I felt pressure on my right calf (a result of loose G-suit fit at this point). Pains occur wherever the G-suit is not snug.

Elevated feeling of excitement and nervousness. A pilot is emotionally highly vulnerable in such a state. He greatly appreciates being treated nicely and notes what a calming effect this has. Good appetite after two hours. I drank a lot: couldn't seem to quench my thirst. Less tiredness than after pulling 7 G's the first day. Feel sort of beat. Head very heavy. Can't focus attention.

It was really good that we did not have to go to 9 the day after pulling 7. Good men!

So it would seem that subjective sensations are more accurate than objective ones? The human body is not a machine!

We are reaching the conclusion that one should go to "work" only on the basis of subjective feelings. The herd instinct (he could do it, and I can do it) when working at high G-loads is intolerable, and deadly dangerous!

Elevated mood all day: you wanted to dance, sing, and joke. Feeling slightly distracted. My entire body feels relaxed. Sense of satisfaction. It might have been tough, but I was able to pull 9 G's!

## Fifth day. Rest.

Slept well, appetite more than normal. In the morning I wanted to stretch and massage my tired muscles. Good mood. Felt great after light calisthenics and a shower! I feel like working. I feel like I've had enough rest. But the voice of reason warns: rest another day—you are after all treading unfamiliar territory.

Tomorrow we'll be working at the same G forces, but with a rapid rate of buildup. I am no longer as nervous as just before pulling 9 G's for the first time, but nevertheless I feel some caution. I've got to be very careful, that is, carry out all the doctor's recommendations, with consideration of my own (minuscule) experience. Learning to work during grayout and loss of peripheral vision will come in handy during actual flying.

## Sixth day. Working with a rapid G force buildup.

Slept well, got plenty of sleep. Following morning calisthenics I saw that yesterday I had foolishly overrated my abilities. Apparently on a day of recovery one must not only passively rest but also take a massage, sauna, soak in the pool, etc. The gluteus muscles still ache, and my right calf also slightly aches. Black and blue marks on the gluteus—from the pressures in pulling 9 G's. Marks of poor G-suit fit on my legs (it must be fit very snugly everywhere). I have a feeling of uneasy tenseness and apprehension. Like before a difficult training sortie (this is probably how the system mobilizes for action).

I know it will be difficult, but nevertheless I am curious about how things will be.

I was number three on the centrifuge, after watching my two buddies. I had drawn up a sequence of procedures for myself. I was sure that I would do just fine.

For future flights I must get to know my own physical limits and learn to expend my energy economically and monitor my condition.

I was able to function with grayout and gun barrel vision at 8 G's. This seemed inconceivable the first time at 8. The training program to prepare for high G forces is very well organized and is comparatively easily assimilated. I

wanted to hold it a bit more at 8 G's. When I saw that the G forces were dropping, I had a sense of dissatisfaction (they were not letting me really get into it). It is probably for this reason that I did not precisely monitor the process of dropoff of G forces. I felt neither mental nor physical tiredness. There was plenty of air. I had this confident feeling that I could work at higher G's, but that feeling of caution remains: after all, you don't adjust so quickly.

I've got to remember: always go into high G forces as if it is the first time.

After working on the centrifuge you don't want to do anything in a hurry. Haste makes you nervous. You are not tired, but you wouldn't mind lying down. I was tired by evening, as if I had flown five sorties that day.

Yes, apparently the best schedule to follow is to get complete but active rest on the day before and the day after pulling 7 G's for 15 seconds. Unless you feel subjectively rested, don't pull high G's. Fatigue did build up over the three days on the centrifuge, although we were able to get rest. An emotional drop, a feeling of apathy. You don't want to do anything, nothing....

The G force training was not easy for us. Nor is it easy now, for our missions are more difficult. And you've got to prepare for them.

A famous general once said: "Difficult in training, easy in battle." But we know that it will not be easy in battle.

After completing the training cycle on the centrifuge, we flew dozens of sorties to practice aerobatic maneuvers and air-to-air combat. And that always means meeting that "grey-eyed beauty"—high G forces. But now we know in advance how it comes on, how it can fool you, how it can get the better of you. But since we know these things, we're not going to let it get us.

Total professional competence and proficiency is a most useful thing.

COPYRIGHT: "Aviatsiya i kosmonavtika", 1989.

### **Training Pilots to Respond to In-Flight Malfunctions and Equipment Failures**

91441288n Moscow AVIATSIYA I KOSMONAVTIKA  
in Russian No 4, Apr 89 (signed to press  
14 Mar 89) pp 36-37

[Article, published under the heading "Flight Safety: Specialist Advice," by Lt Col Med Serv V. Kozlov, candidate of medical sciences; Lt Col V. Sporykhin, candidate of technical sciences; Lt Col Med Serv A. Fedoruk, candidate of medical sciences: "Something Happened...."]

[Text] The helicopter, which had been flying perfectly normally, suddenly banked sharply right. The pilot's first thought was that the autopilot had failed. He instantly did a mental review of the symptoms of a failure of this

nature. Now he had to compare them with information from his instruments and other sources. Everything fit. The response was also obvious: immediately disconnect the autopilot roll axis channel.

But sometimes it happens differently. A pilot may perceive an abrupt banking motion as "buffeting." He will continue flying the helicopter, paying no attention to the increased pressure on the cyclic stick.

Thus we have the same situation, but a differing degree of pilot reliability. Why is this?

The answer is simple. One pilot took part in special experiments and received training in recognizing and identifying in-flight emergencies. The other did not.

Pilot response to the occurrence of a malfunction contains three phases: detection, identification, and corrective action. Detection depends for the most part on how pronounced the so-called attracting effect is. With a well-pronounced attracting effect an abnormal situation immediately attracts attention, regardless of the object toward which it is directed at the given moment. These include malfunctions accompanied by change in the helicopter's attitude, verbalized information, or other clearly-marked phenomena.

Malfunctions with average attracting effect are detected as a rule at the moment of interaction between pilot and source of information and are represented by two types: the first involves visual instrument signals (illuminating annunciator panels, warning flags, etc). These problems include failure or malfunction of instruments, of limiting devices, compressor surge, etc. The second type does not involve instrumental warning. These include electromechanical braking device malfunctions in the roll and yaw channel control system and in the collective-pitch stick loading circuit, etc.

Malfunctions with low attraction effect are detected only by comparison of the status of several systems. These include gradual attitude gyro dropoff and gradual malfunctioning of performance and navigational instrument needles. In order to detect such malfunctions one must compare the readings of the artificial horizon and flight director with redundant and backup instruments.

The process of identifying malfunctions is determined by the presence or absence of specific information on their occurrence. An abnormal situation is easily determined if information is present (annunciator panel or aural warning). Without specific warnings the process of identification requires intellectual effort and takes longer. The speed and accuracy of this process are determined by the level of the pilot's proficiency.

The psychological content of the process is as follows. On the basis of their flying experience, pilots form and consolidate in their memory standard images of various situations, including those which contain a space-time structure of a complex of signals corresponding to specific malfunctions and helicopter behavior. When the

first abnormal indication is perceived, the pilot restores in his memory that malfunction standard image which is most probable for the given malfunction indication. This is followed by active perception of malfunction reference symptoms as they evolve in space and time. If the gathered information corresponds to an actualized standard image, the pilot immediately identifies the abnormal situation. But if a standard image is not formed on the basis of any symptoms, the pilot continues his search-comparison until he identifies the abnormal situation.

Such an identification algorithm is typical of those pilots who have undergone special ground and air training.

A pilot who has not been trained for this kind of procedure does not have emergency situation standard images fixed in his memory during flight, and therefore he makes mistakes or fails to identify a malfunction. For this pilot certain malfunction symptoms and their development with time provide virtually no information.

Identification of an abnormal situation is performed against the background of performance of the flight assignment. Competing interrelationships are established between these two tasks. The busier the pilot is with flying, the longer the process of identifying an abnormal situation will be, but excessive attention to recognition and identification leads to piloting errors.

One widespread shortcoming is making a decision about a malfunction based on the first perceived indication of a problem. The first signal or indication may be a symptom of several abnormal situations. For example, an abrupt drop in cockpit noise level indicates not only engine failure but also air conditioner shutoff. An increase in pressure on the cyclic stick can be caused by quite different things. It is therefore important to remember that no matter how strong the first signal may be, it is unwise to reach a decision pertaining to a malfunction on the basis of this indication alone. It is necessary at all costs to direct attention toward active perception of other signals confirming the presumed malfunction, particularly since various warning devices may be falsely triggered during flight.

Some performance and navigation instrument malfunctions are very difficult to detect and identify, such as a slow attitude gyro dropoff and performance or navigation instrument needle failure. During some phases of a flight it takes as much as 2 minutes to identify such malfunctions. This is the case if a pilot does not compare the readings of his primary, backup, and redundant instruments or does this very rarely. The angular rate of "drop" of the artificial horizon card is less than that which the human eye is capable of immediately detecting. And navigation instrument needles, when failure occurs, go to zero position, which under normal conditions corresponds to precision flying. In addition, before entering clouds, prior to shifting to flying on instruments, that is, visualizing the aircraft's attitude solely on the basis of instrument information, it is

essential to check each instrument to make sure that it is working properly, mutually comparing the readings of the primary, backup, and redundant instruments. When a pilot detects a contradiction between his own sensations (non-instrument signals) and the readings of some instrument, he should make sure the equipment is operating normally before obeying the rule "trust the instruments, not your feelings."

The next phase of a pilot's response in abnormal situations includes execution of a specific algorithm of actions to correct the situation.

The main reason for the occurrence of instances of poor pilot reliability in abnormal or emergency situations is inadequate professional training in problem recognition, identification, and corrective action in unforeseen conditions. Unpreparedness is manifested in pilots' ignorance of an entire group of situations one of the symptoms of which may be the first perceived signal of system malfunction or failure, as well as a space-time structure of specific emergency situations, or in an inability to reason in an algorithmically validated manner in identifying a malfunction and, finally, in poor mastery of the response algorithm to correct an abnormal or emergency situation.

Less than ideal training method is frequently the reason for pilots' inadequate proficiency. Ignoring the pattern and mechanism of man's mental activity in emergency situations may constitute one of the deficiencies of training method. For example, a pilot memorizes the symptoms of malfunctions and corrective actions as described in operating manuals and regulations, but in actual conditions some of the symptoms he has memorized (particularly non-instrument signals) may also occur in situations not involving a malfunction. For example, increased pressure on the cyclic stick due to involuntary application of pressure by the copilot.

The existing method of presenting malfunctions in textbooks and operating manuals is less than optimal in ensuring that the pilot assimilates differential systems of similar malfunctions, since the structure of mental processes is most frequently not reproduced. Probably definite assistance could be rendered by algorithmization of pilot (crew) response in emergency situations which may occur during flight. The principles of the algorithmic approach in regularizing and streamlining response are represented by the block diagrams appearing in this issue of AVIATSIYA I KOSMONAVTIKA, in the item entitled "Responding to an In-Flight Emergency" [pp 24-25 in original document].

The pilot initially perceives a discrepancy between actual flight parameters (or conditions in the cockpit) and intended (normal) parameters. Following analysis of the first symptom, he determines the most probable group to which the malfunction applies. After this he reconstructs in his memory a full picture of the presumed malfunction and, on the basis of a standard

image, effects active perception of information essential to accomplish exact identification of the situation.

Studies confirm the greater effectiveness of the proposed method of training in comparison with current methods of training to respond to emergencies. Proceeding from this, in testing pilot emergency response preparedness it is advisable to formulate questions in such a manner as to assess not only knowledge of symptoms of malfunctions and sequence of actions but also mastery of efficient search for an answer to the question: what has happened?

Here are examples of what in our opinion is a correct statement of pilot-testing scenarios:

"You have noted abnormal pressure on the helicopter cyclic stick...."

"You felt the helicopter suddenly pitch up...."

The pilot should enumerate all possible situations corresponding to these indications. He should then state the differential symptoms of specific situations. After this his superior should add scenario details. Now the pilot's task is precisely to enumerate the sequence of actions in response to the described situation.

Experiments have shown that even when pilots are aware of and expect malfunctions to be introduced, they frequently make mistakes and respond haphazardly if they have not been specifically trained to correct abnormal situations.

Cockpit practice drills are an effective method of training pilots to respond to abnormal in-flight situations, but only when such drills are focused on forming a structure of distribution and switching of attention in the course of detection and identification of specific

abnormal situations in conformity with the space-time structure of incoming information. Malfunction correction algorithms are worked out and correctness of response actions monitored at the same time. When practicing response to emergency situations accompanied by uncertain information (that is, information which is difficult objectively to identify), special attention should be devoted to forming mental procedures pertaining to detecting and identifying them. If a practice session involves a scenario which is distinguished by quite specific information but involving a complex (consisting of several response actions) response algorithm, it is important to ensure that the pilot fully and precisely assimilates this algorithm.

It is obviously high time to think about specially equipped aircraft which would provide capability to practice corrective actions to abnormal in-flight situations directly in the air. Improvement of the pilot's functional reliability is too serious a problem and too great a reserve potential to improve flight safety to doubt the advisability of developing specialized equipment. Pilot professional training methods which are known and used today are good and effective. But are they sufficient?

COPYRIGHT: "Aviatsiya i kosmonavtika", 1989.

#### Listing of Soviet Manned Space Mission Crews

914412880 Moscow AVIATSIYA I KOSMONAVTIKA  
in Russian No 4, Apr 89 (signed to press  
14 Mar 89) pp 40-41

[Table: "Spacecraft Crews"; final part of listing appearing in AVIATSIYA I KOSMONAVTIKA, No 2 and No 3, 1989]

[Text]

Table					
Number	Primary Crew	Backup Crew	Radio Call sign	Spacecraft, Orbital Station	Date and Duration of Mission
1	2	3	4	5	6
37.	Klimuk, Petr Ilich; Mirosław Giermaszewski (PPR)	Kubasov, Valeriy Nikolayevich; Zenon Jankowski (PPR)	Kavkaz	Soyuz 30 - Salyut 6	27 June-5 July 1978, 7 days 23 hours 3 minutes
38.	Bykovskiy, Valeriy Fedorovich; Sigmund Jaehn (GDR)	Gorbatko, Viktor Vasilyevich; Eberhard Kellner (GDR)	Yastreb	Soyuz 31 - Salyut 6	26 August-3 September 1978, 7 days 20 hours 49 minutes
39.	Lyakhov, Vladimir Afanasyevich; Ryumin, Valeriy Viktorovich	Popov, Leonid Ivanovich; Lebedev, Valentin Vitalyevich	Proton	Soyuz 32 - Salyut 6	25 September-19 August 1979, 175 days 36 minutes

Number	Primary Crew	Backup Crew	Table	Spacecraft, Orbital Station	Date and Duration of Mission
			Radio Call sign		
1	2	3	4	5	6
40.	Rukavishnikov, Nikolay Nikolayevich; Georgi Ivanov (PRB)	Romanenko, Yuriy Viktorovich; Aleksandr Aleksandrov (PRB)	Saturn	Soyuz 33	10 April-12 April 1979, 1 day 23 hours 1 minute
41.	Popov, Leonid Ivanovich; Ryumin, Valeriy Viktorovich	Zudov, Vyacheslav Dmitriyevich; Andreyev, Boris Dmitriyevich	Dnepr	Soyuz 35 - Salyut 6	9 April-11 October 1980, 184 days 20 hours 12 minutes
42.	Kubasov, Valeriy Nikolayevich; Bertalan Farkas (HPR)	Dzhanibekov, Vladimir Aleksandrovich; Bela Magyari (HPR)	Orion	Soyuz 36 - Salyut 6	26 May-3 June 1980, 7 days 20 hours 46 minutes
43.	Malyshev, Yuriy Vasilyevich; Aksenov, Vladimir Viktorovich	Kizim, Leonid Denisovich; Makarov, Oleg Grigoryevich	Yupiter	Soyuz T-2 - Salyut 6	5 June-9 June 1980, 3 days 22 hours 19 minutes
44.	Gorbatko, Viktor Vasilyevich; Fam Tuan (SRV)	Bykovskiy, Valeriy Fedorovich; Buy Tkhon Liyem (SRV)	Terek	Soyuz 37 - Salyut 6	23 July-31 July 1980, 7 days 20 hours 42 minutes
45.	Romanenko, Yuriy Vasilyevich; Arnaldo Tamayo Mendez (Cuba)	Khrunov, Yevgeniy Vasilyevich; Jose Arnaldo Lopez Falcon (Cuba)	Taymyr	Soyuz 38 - Salyut 6	18 September-26 September 1980 7 days 20 hours 43 minutes
46.	Kizim, Leonid Denisovich; Makarov, Oleg Grigoryevich; Strekalov, Gennadiy Mikhaylovich	Lazarev, Vasiliy Grigoryevich; Savinykh, Viktor Petrovich	Mayak	Soyuz T-3 - Salyut 6	27 November-10 December 1980, 12 days 19 hours 8 minutes
47.	Kovalenok, Vladimir Vasilyevich; Savinykh, Viktor Petrovich	Zudov, Vyacheslav Dmitriyevich; Andreyev, Boris Smitriyevich	Foton	Soyuz T-4 - Salyut 6	12 March-26 May 1981, 74 days 17 hours 37 minutes
48.	Dzhanibekov, Vladimir Aleksandrovich; Zhugderdemidiyn Gurragecha (MPR)	Lyakhov, Vladimir Afanasyevich; Maydarzhavyn Ganzorig (MPR)	Pamir	Soyuz 39 - Salyut 6	22 March-30 March 1981, 7 days 20 hours 42 minutes
49.	Popov, Leonid Ivanovich; Dumitru Prunariu (SRR)	Romanenko, Yuriy Viktorovich; Dumitru Dediu (SRR)	Dnepr	Soyuz 40 - Salyut 6	14 May-22 May 1981, 7 days 20 hours 41 minutes
50.	Berezovoy, Anatoliy Nikolayevich; Lebedev, Valentin Vityalyevich	Titov, Vladimir Georgiyevich; Strekalov, Gennadiy Mikhaylovich	Elbrus	Soyuz T-5 - Salyut 7	13 May-10 December 1982, 211 days 9 hours 5 minutes



Number	Primary Crew	Backup Crew	Table	Spacecraft, Orbital Station	Date and Duration of Mission
			Radio Call sign		
1	2	3	4	5	6
51.	Dzhanibekov, Vladimir Aleksandrovich; Ivanchenkov, Aleksandr Sergeyevich; Jean-Loup Chretien (France)	Kizim, Leonid Denisovich; Solovyev, Vladimir Alekseyevich; Patrick [Bodri] (France)	Pamir	Soyuz T-6 - Salyut 7	24 June-2 July 1982, 7 days 21 hours 51 minutes
52.	Popov, Leonid Ivanovich; Serebrov, Aleksandr Aleksandrovich; Savitskaya, Svetlana Yevgenyeva	Vasyutin, Vladimir Vladimirovich; Savinykh, Viktor Petrovich; Pronina, Irina Rudolfovna	Dnepr	Soyuz T-7 - Salyut 7	19 August-27 August 1982, 7 days 21 hours 52 minutes
53.	Titov, Vladimir Georgiyevich; Strekalov, Gennadiy Mikhaylovich; Serebrov, Aleksandr Aleksandrovich	Lyakhov, Vladimir Afanasyevich; Savinykh, Viktor Petrovich; Aleksandrov, Aleksandr Pavlovich	Okean	Soyuz T-8	20 April-22 April 1983, 2 days 18 minutes
54.	Lyakhov, Vladimir Afanasyevich; Aleksandrov, Aleksandr Pavlovich	Titov, Vladimir Georgiyevich; Strekalov, Gennadiy Mikhaylovich	Proton	Soyuz T-9 - Salyut 7	27 June-23 November 1983, 149 days 10 hours 46 minutes
55.	Kizim, Leonid Denisovich; Solovyev, Vladimir Alekseyevich; Atkov, Oleg Yuryevich	Vasyutin, Vladimir Vladimirovich; Savinykh Viktor Petrovich; Polyakov, Valeriy Vladimirovich	Mayak	Soyuz T-10 - Salyut 7	8 February-1 October 1984, 238 days 22 hours 50 minutes
56.	Malyshev, Yuriy Vasilyevich; Strekalov, Gennadiy Mikhaylovich; Rakesh Sharma (India)	Berezovoy, Anatoliy Nikolayevich; Grechko, Georgiy Mikhaylovich; Ravish Malhotra (India)	Yupiter	Aoyuz T-11 - Salyut 7	3 April-11 April 1984, 7 days 21 hours 41 minutes
57.	Dzhanibekov, Vladimir Aleksandrovich; Volk, Igor Petrovich; Savitskaya, Svetlana Yevgenyevna	Vasyutin, Vladimir Vladimirovich; Savinykh Vitor Petrovich; Ivanova, Yekaterina Aleksandrovna	Pamir	Soyuz T-12 - Salyut 7	17 July-29 July 1984, 11 days 19 hours 14 minutes
58.	Dzhanibekov, Vladimir Aleksandrovich; Savinykh, Viktor Petrovich	Popov, Leonid Ivanovich; Aleksandrov, Aleksandr Pavlovich	Pamir	Soyuz T-13 - Salyut 7; Soyuz T-13 - Salyut 7; Soyuz T-14	6 June-26 September 1985, 112 days 3 hours 51 minutes; 6 June-21 November 1985, 168 days 3 hours 51 minutes

Table					
Number	Primary Crew	Backup Crew	Radio Call sign	Spacecraft, Orbital Station	Date and Duration of Mission
1	2	3	4	5	6
59.	Vasyutin, Vladimir Vladimirovich; Volkov, Aleksandr Aleksandrovich; Grechko, Georgiy Mikhaylovich	Viktorenko, Aleksandr Stepanovich; Strekalov, Gennadiy, Mikhaylovich; Saley, Yevgeniy Vladimirovich	Cheget	Soyuz T-14 - Salyut 7; Soyuz T-14 - Salyut 7; Soyuz T-13	17 September-21 November 1985, 64 days 21 hours 52 minutes; 17 September-26 September 1985, 8 days 21 hours 13 minutes
60.	Kizim, Leonid Denisovich; Solovyev, Vladimir Alekseyevich	Viktorenko, Aleksandr Stepanovich; Aleksandrov, Aleksandr Pavlovich	Mayak	Soyuz T-15 - Mir - Salyut 7	13 March-16 July 1956, 125 days 1 minute
61.	Romanenko, Yuriy Viktorovich; Laveykin, Aleksandr Ivanovich	Titov, Vladimir Georgiyevich; Serebrov, Aleksandr Aleksandrovich	Taymyr	Soyuz TM-2 - Mir - Soyuz TM-3; Soyuz TM-2 - Mir	6 February-29 December 1987, 326 days 11 hours 38 minutes; 6 February-30 July 1987, 174 days 3 hours 26 minutes
62.	Viktorenko, Aleksandr Stepanovich; Aleksandrov, Aleksandr Pavlovich; Muhammed Ahmed Faris (SAR)	Solovyev, Anatoliy Yakovlevich; Savinykh, Viktor Petrovich; Munir Habib Habib (SAR)	Vityaz	Soyuz TM-3 - Mir - Soyuz TM-2; Soyuz TM-3 - Mir; Soyuz TM-3 - Mir - Soyuz TM-2	22 July-30 July 1987, 7 days 23 hours 5 minutes; 22 July-29 December 1987, 160 days 7 hours 17 minutes; 22 July-30 July 1987, 7 days 23 hours 5 minutes
63.	Titov, Vladimir Georgiyevich; Manarov, Musa Khiramanovich; Levchenko, Anatoliy Semenovich	Volkov, Aleksandr Aleksandrovich; Kaleri, Aleksandr Yuryevich; Shchukin, Aleksandr Vladimirovich	Okean	Soyuz TM-4 - Mir - Soyuz TM-6; Soyuz TM-4 Mir - Soyuz TM-3	21 December 1987-21 December 1988, 365 days 22 hours 39 minutes; 21 December-29 December 1987, 7 days 21 hours 58 minutes
64.	Solovyev, Anatoliy Yakovlevich; Savinykh, Viktor Petrovich; Aleksandr Aleksandrov (PRB)	Lyakhov, Vladimir Afanasyevich; Serebrov, Aleksandr Aleksandrovich; Krasimir Stoyanov (PRB)	Rodnik	Soyuz TM-5 - Mir - Soyuz TM-4	7 June-17 June 1988, 9 days 20 hours 10 minutes
65.	Lyakhov, Vladimir Afanasyevich; Polyakov, Valeriy Vladimirovich; Abdul Ahad Momand (DRA)	Berezovoy, Anatoliy Nikolayevich; Arzamazov, German Semenovich; Muhammed Dauran Gulam Masum (DRA)	Proton	Soyuz TM-6 - Mir - Soyuz TM-5; Soyuz TM-6 - Mir - Soyuz TM-7; Soyuz TM-6 - Mir - Soyuz TM-5	29 August-7 September 1988, 8 days 20 hours 27 minutes; 29 August-7 September 1988, 8 days 20 hours 27 minutes

Table					
Number	Primary Crew	Backup Crew	Radio Call sign	Spacecraft, Orbital Station	Date and Duration of Mission
1	2	3	4	5	6
66.	Volkov, Aleksandr Aleksandrovich; Krikalev, Sergey Konstantinovich; Jean-Loup Chretien (France)	Viktorenko, Aleksandr Stepanovich; Serebrov, Aleksandr Aleksandrovich, Michel Tognini (France)	Donbass	Soyuz TM-7 Mir; Soyuz TM-7 - Mir - Soyuz TM-6	26 November 1988; 26 November-21 December 1988, 24 days 18 hours 7 minutes

COPYRIGHT: "Aviatsiya i kosmonavtika", 1989.

### Thumbnail Operational History of Mir Space Station

91441288p Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 4, Apr 89 (signed to press 14 Mar 89) pp 42-43

[Article, published under the heading "The Space Program Serving Science and the Economy," by USSR Academy of Sciences Corresponding Member Hero of Socialist Labor Yu. Semenov, Lenin Prize and State Prize recipient: "Three Years in Orbit"; concluding part of two-part article; see AVIATSIYA I KOSMONAVTIKA, No 2, 1989]

[Text] The Kvant astrophysical module, one of the first specialized scientific laboratories, was introduced in April 1987 as part of the Mir orbital complex. The Kvant module as equipped with the unique Rentgen orbital observatory, consisting of the Pulsar X-1, GEKSE, TTM, and Siren-2 X-ray telescopes. Comprehensive study of X-ray sources in the range 2-800 keV was conducted with the aid of this system, developed by scientists from the USSR, FRG, Great Britain, the Netherlands, and the European Space Agency.

Observation of the supernova 1987A in the Large Magellanic Cloud with the aid of this module was the most significant astronomical event of 1987. Examination of the unusual shape of the source's energy spectrum in the X-ray band and the course of its evolution with time will make it possible to refine and detail physical models of similar processes. The international scientific community has acknowledged the results of these studies to be outstanding. They have been published in leading Soviet and foreign scientific journals and presented at international conferences.

The Glazar ultraviolet telescope commenced studying the heavens on the heels of the Rentgen observatory. This telescope is designed primarily to investigate the activity of quasars and galactic nuclei. It has been used to photograph various parts of the celestial sphere in the region of the constellations Puppis, Grus, Pavo, Andromeda, Piscis Austrinus, Gemini, Carina, Ursa Major, and Cetus, in the vicinity of the stars Alpha

Pavonis and Alpha Eridani, as well as the supernova in the Large Magellanic Cloud.

Study of the electron-positron component of the earth's inner radiation belts in the range 20-200 MeV was performed by the Mariya-2 magnetic spectrometer. It has been established that the mechanism of accumulation of electrons and positrons in magnetic "traps" varies. Approximately 700 astrophysical observation sessions have been conducted during the three years in orbit of the Mir complex. These investigations are continuing today.

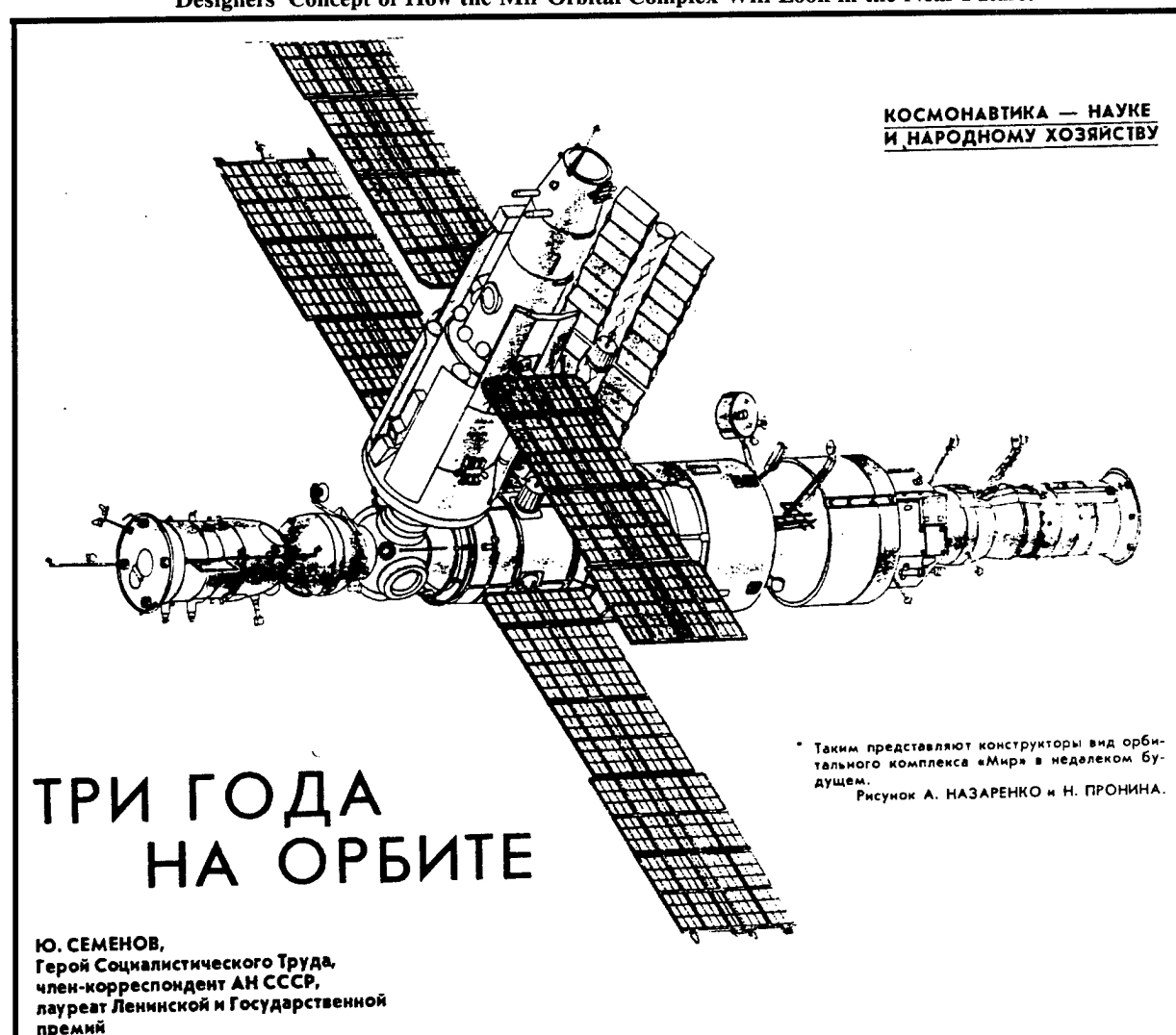
A great deal of time is devoted to geophysical experiments as well. All branches and sectors of the economy connected with natural resources make use of the results of observations conducted with the employment of photometric and spectrometric equipment (KATE-140, Hasselblad, Sever, MKS-M, Niva video system). This equipment has helped gather a data bank of information on earth resources in the World Ocean, a program sponsored by Interkosmos, plus development of a method of combined geophysical investigations with employment of ground, airborne, and other assets.

On the basis of agreements with a number of countries, their territories were photographed with various-format cameras. A total of 125 photography sessions were conducted, and a total of more than 1,400 frames were taken.

In response to requests by geologists, refined data were obtained on the oil and gas bearing areas of the Caspian region and geologic structures in the Sikhote-Alin and Caucasus ranges.

Pastures in the Tashkent area were photographed for USSR Gosagroprom. Crops were monitored in the Ukraine, on the Volga, and in Central Asia. Degree of environmental pollution was determined in the vicinity of large cities: Orenburg, Karaganda, and Kharkov. The environmental situation was examined in the Transbaikalian and in the Pripyat area. All this made it possible more accurately to determine the culpability of various enterprises whose activities are harming the environment. An endeavor to utilize the results of space-based observations in ecological and environmental studies is a typical trend of recent years.

## Designers' Concept of How the Mir Orbital Complex Will Look in the Near Future.



A total of 650 observation sessions dedicated to various branches and sectors of the economy were conducted. An experimental system was developed, to provide surveillance of meteor activity, to collect statistical data and determine density of the atmosphere-penetrating stream of meteoric particles.

Space technology promises considerable economic benefit. An extensive research program has been provided in this area. For example, Splav, Korund, and Korund-1M units were certified for producing single-crystal semiconductor materials (silicon, gallium arsenide) in space. The Korund-1M, for example, can produce crystals 25 mm in diameter and up to 10 cm long within a working temperature range of 200 to 1200 degrees C. A microcomputer made it possible to conduct a series of experiments to develop basic industrial processes. In the near future this will enable us to set up mass production of semiconductor materials in conditions of weightlessness.

A series of experiments in the manufacture of thin-film roll material using polymer film was performed on Yantar equipment. Repeated drawing of a three-meter roll through a stream of vaporized copper resulted in producing specimens of copper foil with improved mechanical protective properties.

Investigation of the behavior of structural materials and protective coatings in the process of operation of the Mir complex was done with the Elektrotopograf-7M unit. This equipment made it possible to trace the dynamics of change in the protective and dielectric properties of structural materials in conditions of space. Rates of progress of chemical reactions in weightlessness were studied with the Biryuz unit.

The development of technology and equipment to perform repairs and refurbishing in space constituted an important

area in technological research and experimentation. A universal hand tool (URI) was designed, built and tested at the Institute imeni Ye. O. Baton based on the results of tests of the Ispartel and Ispartel-M units. Positive test results in soldering, brazing, welding, cutting, and spray-coating metals made it possible to develop tools for repair and refurbishing operations in space. The result was the Universal, which is scheduled for delivery to the orbital complex in 1989.

The Mir orbital complex offers extensive possibilities for performing industrial experiments with the Ruchey, Tavriya, Genom, EFU-Robot, Svetlana, and Aynur equipment. The space station crew used the Ruchey unit to work on development of a basic drug manufacturing process for the mass production of medical preparations aboard future large-scale space complexes. Five series of experiments were conducted on separation of human blood proteins and purification of antiviral interferon and an antiinfluenza preparation for producing test batches of antisera. Two experiments were performed with the Svetlana automated electrophoresis unit, designed for the separation of batched quantities of active microorganisms producing a livestock-feed antibiotic for agriculture.

Large homogeneous protein crystals were grown on the Aynur unit. Large and homogeneous crystals are the key to discovering the secrets of the structure of proteins both in basic research and in accomplishing practical tasks. A total of five series of experiments were performed on this unit.

At the same time considerable attention was devoted to biomedical research aimed at creating the biological elements of life-support systems. A first step in this direction was study of living conditions of cosmonauts using biologically active substances of natural origin. A number of new phenomena connected with heredity, variability of biological forms and individual development were discovered in the process of space flight. Basic directions of future research have been laid out.

A series of biological experiments was performed to determine optimal conditions for cultivating higher plants in space greenhouses. The Fiton and Rost units, for example, were used to examine cultures of plant and animal tissue, seeds, and germinating plants from the standpoint of resistance of biological systems to the effect of factors of space flight. The obtained results will be used in solving fundamental scientific problems and in developing future life-support systems for manned spacecraft.

The medical research conducted aboard the Mir complex was aimed at solving two basic problems: maintaining the health and fitness of cosmonauts during extended flights, and obtaining data on the mechanisms of functioning of the organism and on man's behavior in unaccustomed conditions.

Obtained results can be used by doctors in cardiological, neurological, and surgical practice and in medical fitness examination.

The Mir complex has entered its fourth year in orbit. In the future it will be outfitted with equipment which new modules will deliver. New research awaits the cosmonauts. Some of this research will be conducted by A. Volkov, S. Krikalev, and V. Polyakov—the fourth resident crew.

COPYRIGHT: "Aviatsiya i kosmonavtika", 1989.

### **Radio Control Systems Designer Ryazanskiy Honored**

91441288q Moscow AVIATSIYA I KOSMONAVTIKA  
in Russian No 4, Apr 89 (signed to press  
14 Mar 89) pp 44-45

[Article, published under the heading "Readers Request," by B. Pokrovskiy, chairman of the Space Command, Control and Telemetry Complex Veterans Council: "Radio Control Systems Chief Designer"]

[Text] The workforces at numerous scientific research institutes, design offices, and plants which design and build rocket and space hardware have long been well familiar with the name and career of Mikhail Sergeyevich Ryazanskiy, eminent Soviet scientist and designer of radio control systems for rockets, satellites, unmanned interplanetary probes, manned spacecraft, land and seagoing technical facilities of the space command, control and telemetry complex. The general reader, however, unfortunately knows little about this outstanding individual, due in part to the fact that the activities in which M. Ryazanskiy was engaged and which he directed were for many years considered classified activities, not always with justification. There is also another reason: Mikhail Sergeyevich's exceptional personal modesty.

I remember that when I was working on a book about the KIK [Space Command, Control and Telemetry Complex], I asked Ryazanskiy to tell something about himself and give me a photograph of himself in order to acquaint readers with him. It took quite some time to persuade this scientist to select a photograph for the book; he refused to say anything about his career.

It was finally after Mikhail Sergeyevich's passing (he died on 5 August 1987) that I had to reconstruct piece by piece, from the materials in this scientist's archives, which were very small, the brilliant career of one of the pioneers of rocket and space science and technology.

Mikhail Sergeyevich was born in Saint Petersburg on 5 April 1909. His family soon moved to Baku, where his father worked as an economist in the oil industry, and his mother taught school. The future designer was an amateur radio enthusiast from his teenage years. Radio henceforth became his lifelong interest.

In 1928 the family moved to Moscow, where M. Ryazanskiy took his first job. He was employed as a benchman at the Society of Friends of Radio. On assignment by the Moscow Committee of All-Union Komsomol, Komsomol member Ryazanskiy, who was also serving as deputy chairman of the Moscow section of the shortwave amateur radio organization, engaged with enthusiasm in promoting amateur radio among Moscow youth.

This able, active enthusiast of the then new radio technology was soon assigned to the famed Nizhniy Novgorod Radio Laboratory imeni V. I. Lenin (NRL). This was the first Soviet scientific research center in the field of radio engineering. V. I. Lenin personally formulated and on 2 December 1918 signed the "Statute on NRL With Shop of the People's Commissariat of Postal and Telegraph Service." V. Leshchinskiy, M. Bonch-Bruyevich, V. Lebedinskiy, and other prominent engineers and scientists were the laboratory's organizers and first directors.

The projects developed at the NRL became the scientific-technical and organizational foundation of Soviet radio communications, including our first radio broadcast station imeni Comintern. The radio laboratory's fruitful work was rewarded by two-times award of the Order of the Red Banner of Labor, which for that time, which was not very generous in the bestowal of awards, constituted extraordinarily high government recognition. In 1928 the laboratory became part of the Leningrad Central Radio Laboratory of the electronic plants trust.

I am going into such detail about the NRL because it played an important role in M. Ryazanskiy's career. It was there that he became a professional and was sent to study at the Leningrad Electrical Engineering Institute.

Due to a serious lung ailment, Ryazanskiy was advised to get away from the damp climate of the city on the Neva. He completed his education at the Moscow Power Engineering Institute, graduating with honors in 1935.

Two years before graduating from the institute Mikhail Sergeyevich went to work at the OTB—the Special Technical Office, which subsequently became the leading scientific research institute in its branch. At this office M. Ryazanskiy took part during the Great Patriotic War in developing the first radar equipment for the military. For this work he was awarded a USSR State Prize and the Order of the Red Star.

In the victorious spring of 1945 M. Ryazanskiy, as an experienced specialist, was sent to Germany to study the Third Reich's vaunted "retaliation weapons," the V-1 buzz bomb and the V-2 ballistic missile. While in Germany he worked with S. Korolev, V. Glushko, N. Pilyugin, V. Kuznetsov, and V. Barmin. It was they who subsequently formed the famous Chief Designers Council.

Soon, pursuant to a proposal by D. F. Ustinov, Mikhail Sergeyevich was named chief engineer at one of the new

scientific research institutes established subsequent to the well-known decision dated 13 May 1946 to further the development of Soviet rocket engineering.

Between 1947 and 1951 Ryazanskiy took part, together with other scientists and engineers, in flight testing at the Kapustin Yar missile range the first Soviet ballistic missiles, the R-1 and R-2, for which radio monitoring and radio control systems were developed under his direction. He subsequently served as a ministry main administration chief. But administrative duties were not to Mikhail Sergeyevich's liking, and he soon returned to his scientific research institute as chief designer.

As a State Commission member in 1957, M. Ryazanskiy took part in preparing for and carrying out the launch of the first Soviet satellite, which was boosted into orbit by a rocket containing a radio control system developed under his direction. In 1958 Mikhail Sergeyevich brilliantly defended his dissertation for the academic degree of doctor of technical sciences.

The quintessence of M. Ryazanskiy's creative activities was the giant RT-70 radio telescope with the world's first fully rotatable quasi-parabolic dual-reflector multiband antenna system with a primary reflector diameter in excess of 70 meters. The first such system entered service in 1978 at the Yevpatoriya Deep Space Communications Center, and the second unit was installed at a tracking station of the Space Command, Control and Telemetry Complex in the Far East, near Ussuriysk.

The RT-70 helped ensure flawless missions by many interplanetary probes, including the Vega 1 and Vega 2 which, responding to earth command, performed unique investigations of Venus and its atmosphere and, traveling more than 1.2 billion kilometers along a heliocentric orbital path, accomplished a rendezvous with Comet Halley with astounding precision. While already gravely ill at that time, Mikhail Sergeyevich followed with great interest the progress of this magnificent experiment, the last one of his life.

"All my father's thoughts, his time at work and away from work," stated his son Nikolay Mikhaylovich, "were focused on his work. He was always thinking about it and talking about it, with the exception of those rare leisure hours which he enthusiastically devoted to reading. My father was well acquainted with and loved the Russian, Soviet, and foreign classics and endeavored to keep up with new works of literature. Reading served as somewhat of a diversion from the sad experiences which befell him in his last years: the death of his wife, the tragic death of his older son and, perhaps the most important—the fact that he was unable to work at full effort in his scientific research institute due to his grave illness."

Work in the field of deep-space communications brought M. Ryazanskiy together with chief designer of interplanetary probes G. Babakin, who on many occasions visited him at home and at his country place to confer and share his ideas and plans. M. Ryazanskiy maintained warm, friendly relations with S. Korolev and particularly with

N. Pilyugin from 1945 on. This friendship provided them moral enrichment and was very helpful to the cause to which they devoted their lives.

Mikhail Sergeyevich took active part in civic activities and served as a delegate to the 21st and 22nd CPSU Congresses. USSR Academy of Sciences Corresponding Member M. Ryazanskiy was honored for his distinguished service to the homeland by award of the title Hero of Socialist Labor and by award of a Lenin Prize and a USSR State Prize. He was five times awarded the Order of Lenin, awarded of the October Revolution, twice awarded the Order of the Red Banner of Labor, and awarded the Order of the Red Star, plus numerous medals.

COPYRIGHT: "Aviatsiya i kosmonavtika", 1989.

### **Lack of Flight Data Recorder Tape Analysis Skills Lamented**

91441288r Moscow AVIATSIYA I KOSMONAVTIKA  
in Russian No 4, Apr 89 (signed to press  
14 Mar 89) p 45

[Article, published under the heading "Letters From Readers," by Gds Capt N. Mazunin, chief, performance monitoring group: "Learning From One's Own Mistakes"]

[Text] Mistakes in aviation cost dearly, regardless of who made them. They are diverse. Some occur as a result of negligence and lack of conscientiousness, while others are due to lack of experience or lack of pilot proficiency. One can easily assess the first category, but how about the second?

Gds Capt S. Yegorov made the same mistake twice: on both his first and second training sortie of the day he substantially exceeded the maximum allowable G forces during dive recovery. One might ask how could it happen that a pilot who had already gotten himself into a mishap-threatening situation was permitted to go up again? The answer is simple. It seems that in analyzing the flight data recorder tape, performance monitoring group specialist Gds Sr Lt N. Kozlov was unable to determine that the parameter in question had exceeded the allowable limit, while the pilot either had failed to notice his mistake or decided to say nothing about it. In any case my subordinate was indirectly to blame for what happened in the air.

Let us not be hasty with conclusions, however. I am far from implying that this officer displayed carelessness or negligence. That is not in Kozlov's character, and as group chief I cannot make any such charge. He simply lacked experience.

Why is it that the professional development of those who guard flight safety drags on so long? There are two reasons for this, in my view. First of all, at the present time specialists in this area are not trained at military educational institutions, and performance monitoring groups obtain personnel in the form of engineers and

technicians from the squadrons and aircraft maintenance units. For example, Kozlov and I formerly worked as aircraft equipment technicians. Naturally we had to learn a great deal from the ground up.

Secondly, skilled analysis of flight data is so complicated that it is difficult fully to master it in a short period of time, especially in conditions of intensive combat training. It is easy to determine a bad landing or other adverse deviation in flight parameters. But it is a very easy matter to confuse an Immelman with a chandelle or to miss the mark indicating squeezing of the ordnance release button. And this kind of thing has happened in our group.

Is there really no way to accelerate the training of specialists in our field? I believe there is. When I was stationed in the North Caucasus Military District I happened to attend training conferences for group chiefs. I remember that they began with testing the officers' practical skills in analyzing complicated flight situations on the basis of flight data recorder tapes. And although I had been serving in this capacity for more than half a year by that time, I am ashamed to admit that I received a mark of unsatisfactory. But in these brief training courses the amount of knowledge I acquired would have taken months or even as much as a year of practical work in the line regiment to acquire.

Under the supervision of experienced, veteran specialist personnel, we meticulously examined tapes with various flight parameter deviations and learned to recognize on the basis of flight data recorder tape patterns faulty pilot actions and malfunctions of aircraft systems and components. In addition we exchanged the experience and know-how we had gained in our own units.

Similar brief training courses were held in the Transbaikalian Military District. Unfortunately their level was much lower. For the most part the participants examined the general rules and procedures pertaining to organization of pilot performance monitoring during flight operations shifts and the rules and procedures of operating and servicing the equipment. This also is necessary, but it is not enough, for some of the officers had not been working long in the performance monitoring group. These brief courses probably should have been given a more practical directional thrust.

It would be a good idea to have group technicians attend such training activities. You won't find many opportunities in a line unit to discuss and analyze, in a businesslike and calm environment, utilizing extensive statistical material, a given in-flight mishap-threatening situation or to train and practice in determining errors by flight personnel.

Our job would be greatly facilitated by methodological literature, which we lack at the present time. But there are highly-trained specialists at higher headquarters, persons capable of drawing up valuable recommendations pertaining to analysis of the most complicated in-flight situations. I would like to have a large quantity of diversified informational material.

Of course these are only my suggestions. Perhaps they have not been thoroughly thought through, and maybe there are some debatable points. But we must find a solution. Flight safety is incompatible with incompetence. Learning from our own errors sometimes costs dearly.

COPYRIGHT: "Aviatsiya i kosmonavtika", 1989.

### Diagram of Soviet Space Shuttle

91441288s Moscow AVIATSIYA I KOSMONAVTIKA  
in Russian No 4, Apr 89 (signed to press  
14 Mar 89) back cover

[Diagram: "Diagram of Buran Space Shuttle"]

[Text]

COPYRIGHT: "Aviatsiya i kosmonavtika", 1989.

### Articles Not Translated From AVIATSIYA I KOSMONAVTIKA No 4, April 1989

00000000 Moscow AVIATSIYA I KOSMONAVTIKA in  
Russian No 4, Apr 89 (signed to press 14 Mar 89) p 48

[Text]

At the Beginning of a Glorious Journey  
(Ye. Sergeyev) .....pp 12-13

It Depends on Us (Zh. Isigenov) .....pp 16-17

Two Methods Debated (A. Voynov) .....pp 16-17

### Between the Lines of a Recommendation

(A. Bondarenko) .....p 20

Behind Enemy Lines (B. Nalivayko) .....pp 32-33

Designer of the IIs (A. Ayupov) .....pp 33-35

Together or Nobody (V. Ovsyannikov) .....pp 38-39

Commanders of Cosmonaut Corps .....p 43

Under Balkan Stars (L. Lisitskiy) .....pp 46-47

History of Aviation in Models .....p 48

COPYRIGHT: "Aviatsiya i kosmonavtika", 1989.

### Publication Data

91441288u Moscow AVIATSIYA I KOSMONAVTIKA  
in Russian No 4, Apr 89 (signed to press 14 Mar 89)

[Text] English title: AVIATION AND COSMONAUTICS

Russian title: AVIATSIYA I KOSMONAVTIKA

Editor: O. A. Nazarov

Publishing house: Voenizdat

Place of publication: Moscow

Date of publication: April 1989

Signed to press: 14 March 1988

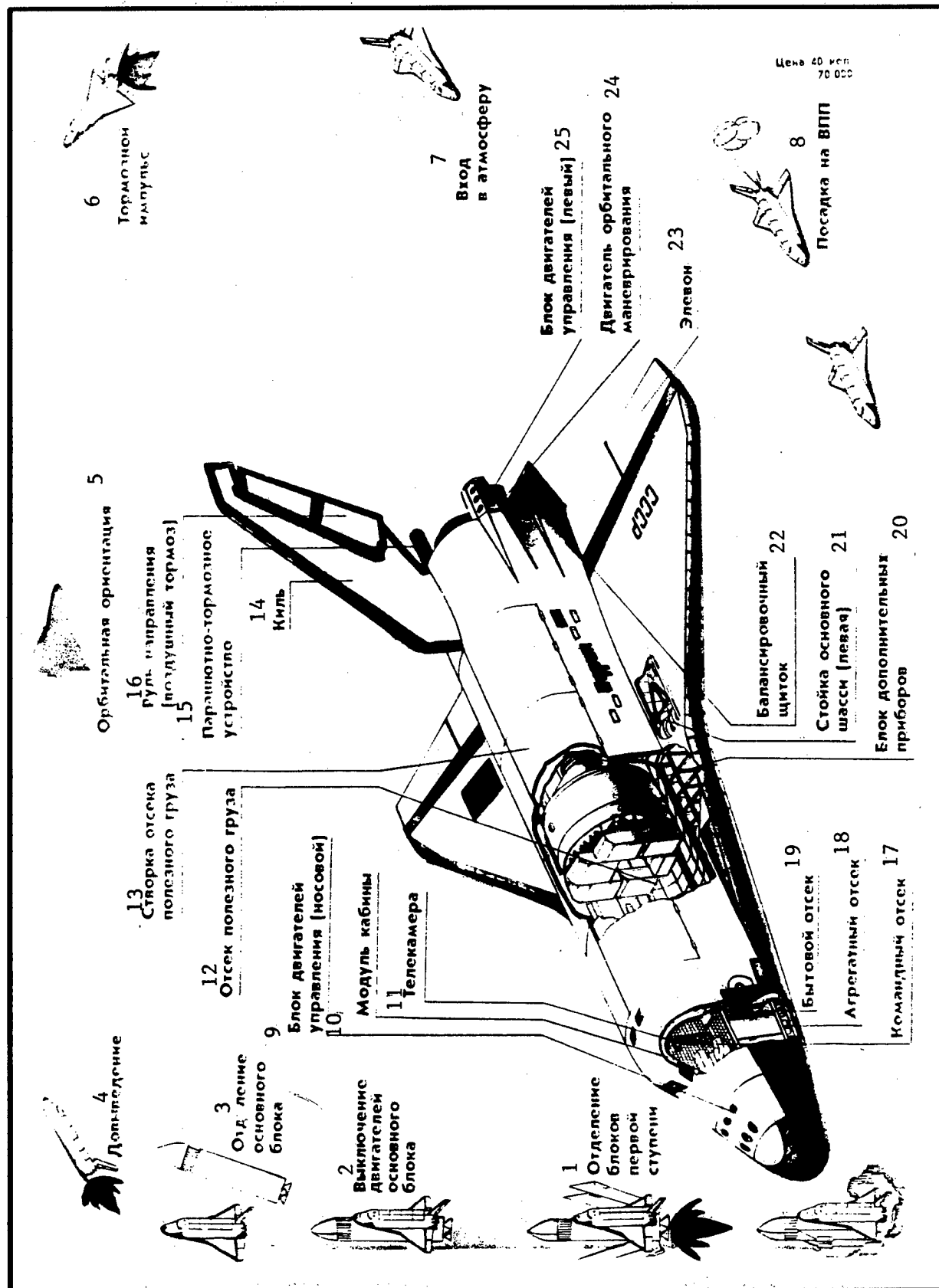
COPYRIGHT: "Aviatsiya i kosmonavtika", 1989.

### Key:

1. First-stage separation
2. Launch vehicle central core stage engine shutdown
3. Central core stage separation
4. Final orbital insertion
5. Orbital attitude
6. Deorbit burn
7. Atmosphere reentry
8. Conventional runway landing
9. Engine control unit (nose)
10. Flight deck module
11. TV camera
12. Payload bay

13. Payload bay door
14. Vertical tail
15. Brake chute
16. Rudder (air braking device)
17. Flight deck
18. Service bay
19. Crew quarters
20. Additional instrumentation unit
21. Main gear (left)
22. Trim flap
23. Elevon
24. Orbital maneuvering motor
25. Attitude thrusters (left)





22161

85

NTIS

ATTN: PROCESS 103

5285 PORT ROYAL RD

SPRINGFIELD, VA

22161

This is a U.S. Government publication, policy, view, or attitude. It is not to be cited as an official position of the U.S. Government or as an official position of any agency of the U.S. Government unless it is clearly identified as such. Cite FBIS or JPRS provided they do so in a manner clearly identifying them as the secondary source.

Foreign Broadcast Information Service (FBIS) and Joint Publications Research Service (JPRS) publications contain political, economic, military, and sociological news, commentary, and other information, as well as scientific and technical data and reports. All information has been obtained from foreign radio and television broadcasts, news agency transmissions, newspapers, books, and periodicals. Items generally are processed from the first or best available source; it should not be inferred that they have been disseminated only in the medium, in the language, or to the area indicated. Items from foreign language sources are translated; those from English-language sources are transcribed, with personal and place names rendered in accordance with FBIS transliteration style.

Headlines, editorial reports, and material enclosed in brackets [ ] are supplied by FBIS/JPRS. Processing indicators such as [Text] or [Excerpts] in the first line of each item indicate how the information was processed from the original. Unfamiliar names rendered phonetically are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear from the original source but have been supplied as appropriate to the context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by the source. Passages in boldface or italics are as published.

#### SUBSCRIPTION/PROCUREMENT INFORMATION

The FBIS DAILY REPORT contains current news and information and is published Monday through Friday in eight volumes: China, East Europe, Soviet Union, East Asia, Near East & South Asia, Sub-Saharan Africa, Latin America, and West Europe. Supplements to the DAILY REPORTs may also be available periodically and will be distributed to regular DAILY REPORT subscribers. JPRS publications, which include approximately 50 regional, worldwide, and topical reports, generally contain less time-sensitive information and are published periodically.

Current DAILY REPORTs and JPRS publications are listed in *Government Reports Announcements* issued semimonthly by the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, Virginia 22161 and the *Monthly Catalog of U.S. Government Publications* issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

The public may subscribe to either hardcover or microfiche versions of the DAILY REPORTs and JPRS publications through NTIS at the above address or by calling (703) 487-4630. Subscription rates will be

provided by NTIS upon request. Subscriptions are available outside the United States from NTIS or appointed foreign dealers. New subscribers should expect a 30-day delay in receipt of the first issue.

U.S. Government offices may obtain subscriptions to the DAILY REPORTs or JPRS publications (hardcover or microfiche) at no charge through their sponsoring organizations. For additional information or assistance, call FBIS, (202) 338-6735, or write to P.O. Box 2604, Washington, D.C. 20013. Department of Defense consumers are required to submit requests through appropriate command validation channels to DIA, RTS-2C, Washington, D.C. 20301. (Telephone: (202) 373-3771, Autovon: 243-3771.)

Back issues or single copies of the DAILY REPORTs and JPRS publications are not available. Both the DAILY REPORTs and the JPRS publications are on file for public reference at the Library of Congress and at many Federal Depository Libraries. Reference copies may also be seen at many public and university libraries throughout the United States.